SANTA ROSA FIRES

National Fire Coordination Study

U.S. DEPARTMENT OF AGRICULTURE/FOREST SERVICE/DIVISION OF FIRE CONTROL

SANTA ROSA FIRES

Study Report

Hanley, Nuns Canyon, and Mt. George Fires

September 18-27, 1964

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California State Division of Forestry Cooperating

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TABLE OF CONTENTS

		Page
	LIST OF TABLES	iv
	LIST OF FIGURES	v
I.	INTRODUCTION	1
II.	DESCRIPTION OF THE FIRES	5
	A. Location	5
	B. Topograpraphy	5
	C. Fuels	6
	D. Weather	8
	E. Agencies and Fire Services Involved	10
	F. Chronological Course of the Fires	12
	G. Casualties	19
	H. Rate of Spread	19
	I. Damage	20
	J. Rehabilitation	22
III.	ANALYSIS	23
	A. Utilization of Capabilities	23
	B. Fire Suppression Problems	34
	C. Successful Techniques for Saving Structures	40
	D. Pre-Disaster Planning	41
IV.	CONCLUSIONS AND RECOMMENDATIONS	45
V.	APPENDICES	53

LIST OF TABLES

Number		Page
1	Acres Burned by Fuel Type -- 3 Fires	6
2	Fire Suppression Forces Employed	12
3	Damage to Improvements	21
4	Damage to Vegetation	22
5	Damage to Watershed and Recreation (est.)	22
6	Summary of Aircraft Use	39

LIST OF FIGURES

Number		Page
1	Map of the Hanley, Nuns Canyon, and Mt. George fires and approximate locations of several other fires that burned in the same period.	vi
2	Map of fires, showing positions of the head at various times and locations of C.D.F. Fire Stations.	4
3	Hanley fire about 1:00 p.m., September 21.	7
4	House burning on Franz Valley School Road.	9
5	North (rear) side of Hanley fire, about 1:00 p.m., September 21.	14
6	Fire Limits in Calistoga, Hanley fire.	15
7	Nuns Canyon fire near Kenwood.	18
8	Fire fighters taking independent action to save structures.	24
9	Mutual aid pumpers from the City of Vallejo, being filled with water.	30
10	Residence saved by fire fighters in Boyes Hot Springs, Nuns Canyon fire.	42

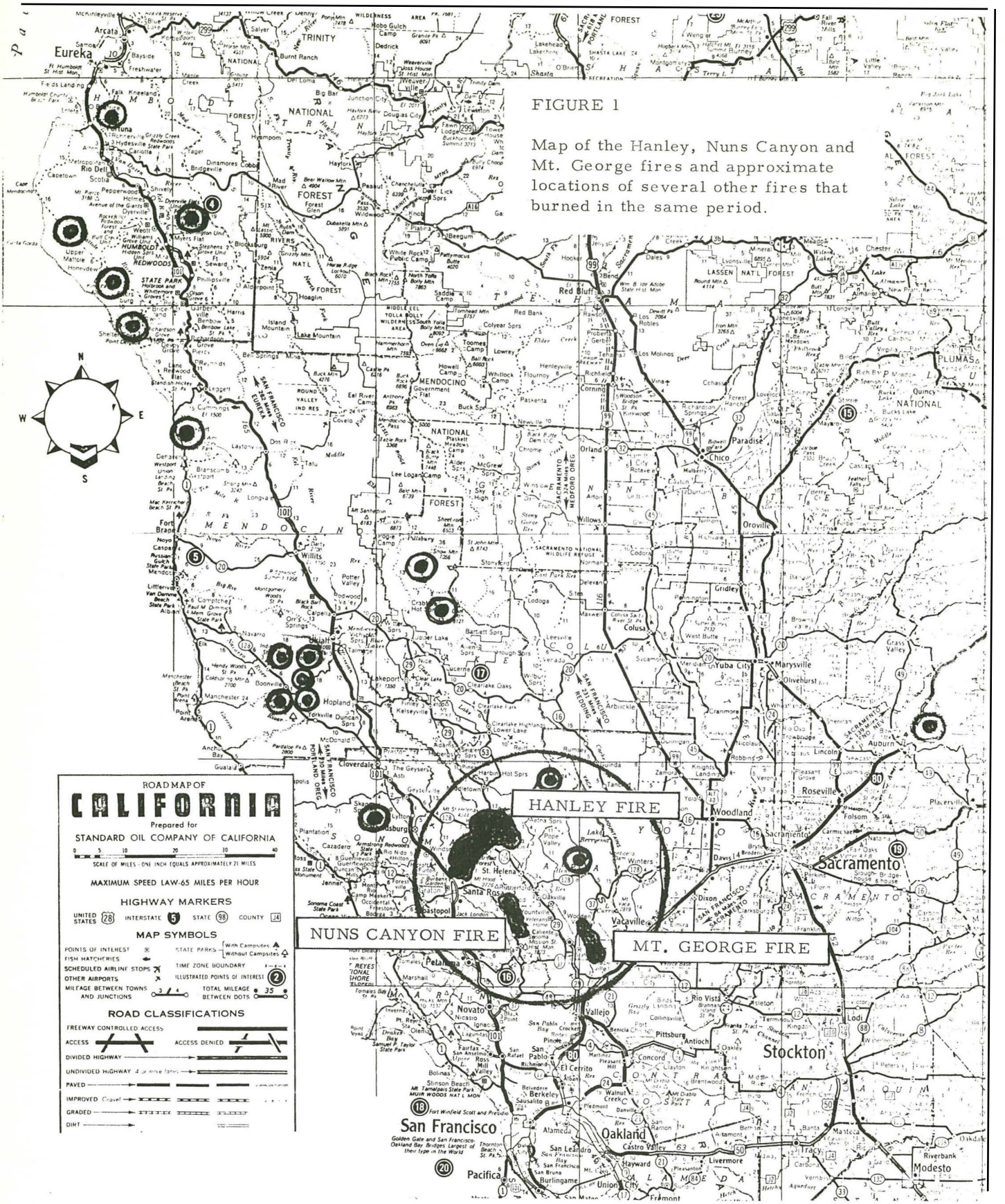
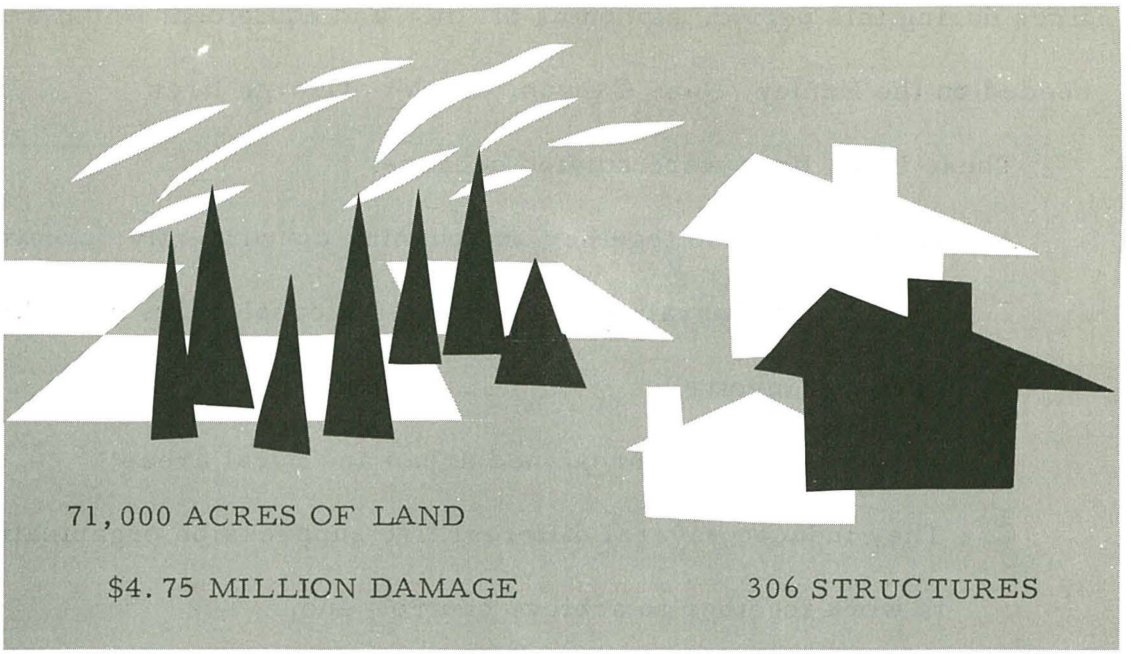


FIGURE 1

Map of the Hanley, Nuns Canyon and Mt. George fires and approximate locations of several other fires that burned in the same period.



I. INTRODUCTION

A trio of fires -- Hanley, Nuns Canyon, and Mt. George -- simultaneously threatened the California communities of Santa Rosa, Calistoga, Napa, and Boyes Springs on September 21 and 22, 1964. They ravaged 71,601 acres of land and 306 structures, causing more than $4.75 million in damage. The cost of suppressing the fires was $787,000. During the peak of the threat, fire service resources were forced to fight 17 additional fires, ranging up to 15,000 acres in size, in the same general area. (Figure 1.)

During the period September 18-27, the California State Division of Forestry suppressed 364 fires which covered 103,435 acres. The U.S. Forest Service, counties and other jurisdictions also had many

fires during this period, siphoning off men and equipment which were needed on the Hanley, Nuns Canyon, and Mt. George fires.

These three fires were studied because:

A. They were close together and burning concurrently, creating a major conflagration which taxed the capabilities of the fire services involved;

B. They damaged or threatened urban and rural areas;

C. They induced several different fire suppression organizations to work together to achieve control; and,

D. They present an example of how rural fires resulting from nuclear attack could threaten the lives and property of people in urban areas.

A description of how this study was conducted is included in the Appendix. (Appendix A.) Persons interviewed are listed in Appendix B.

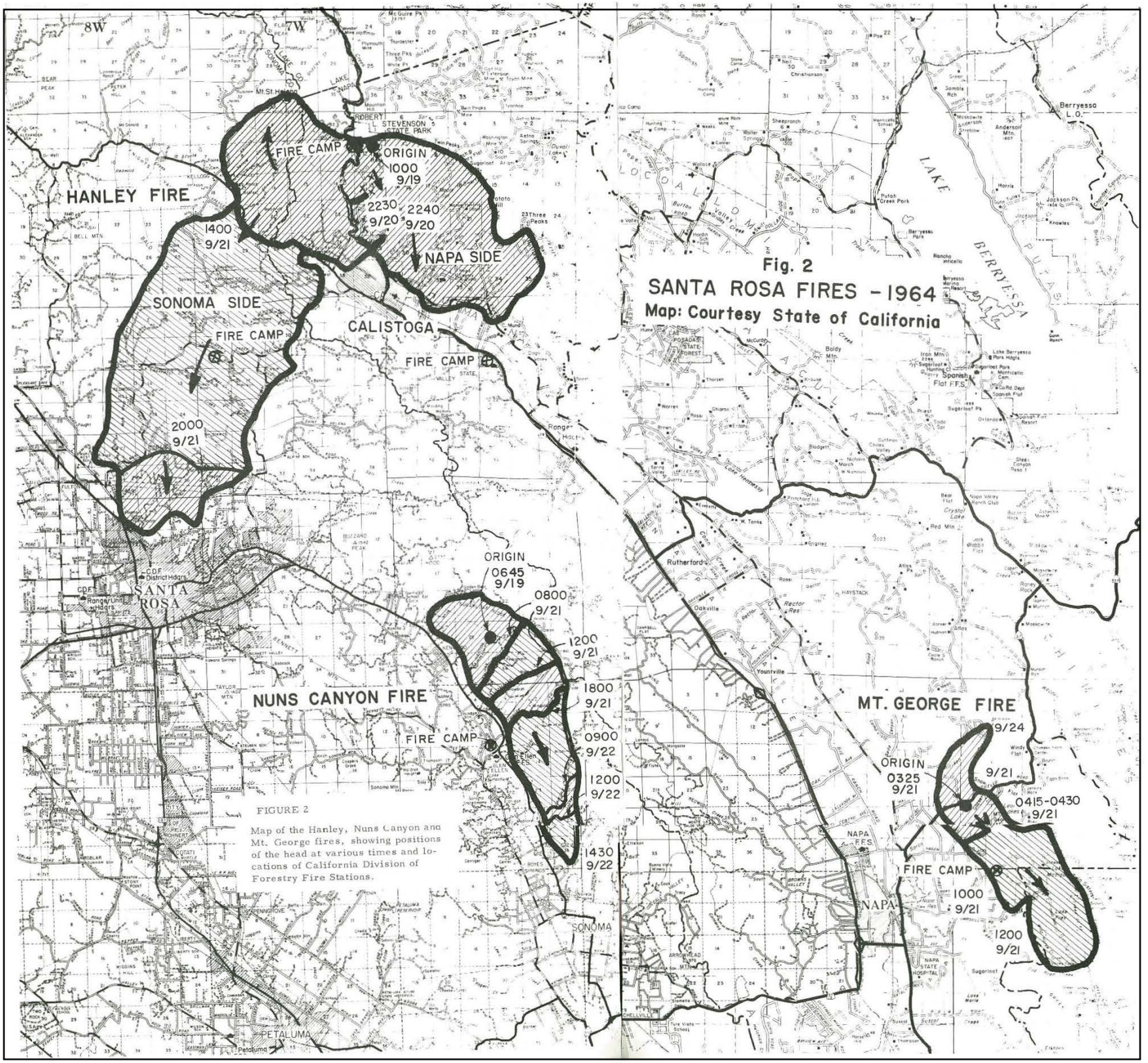


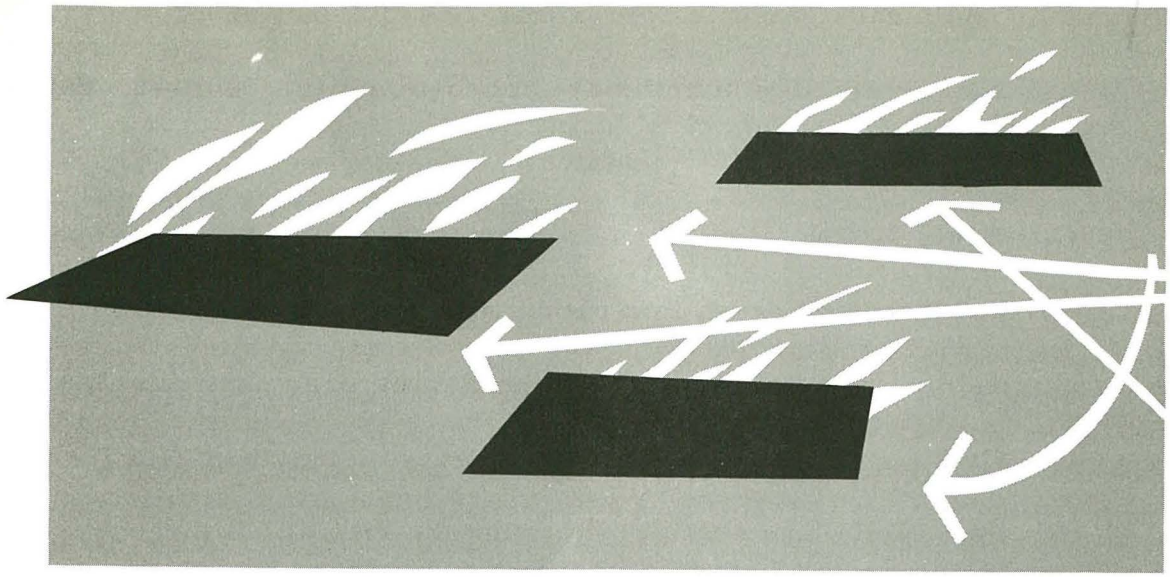
Fig. 2

SANTA ROSA FIRES - 1964

Map: Courtesy State of California

FIGURE 2

Map of the Hanley, Nuns Canyon and Mt. George fires, showing positions of the head at various times and locations of California Division of Forestry Fire Stations.



II. DESCRIPTION OF THE FIRES

A. Location -- The three fires were in an area approximately 45 miles north of San Francisco and 35 miles inland, in the center of the northern California wine growing region. The fires were spaced approximately 12 miles apart along a crescent running from Santa Rosa on the north to Napa on the south. (Figure 2.) Statistics of the fires are included in Appendix C. Appendix D lists fires that were burning during the same period as the three study fires. These fires created problems of supply and resource distribution that had a direct effect on the control of the study fires.

B. Topography -- The topography in the area is mountainous, with steep and rolling hills interspersed with small valleys.

The highest point is approximately 4,000 feet above sea level, while the valley bottoms are approximately 1,000 feet. Summers are hot and dry; winters are rather wet.

C. Fuels -- The wildland fuels consist mostly of brush, timber, and woodland grass in a patchy arrangement as shown in Table 1 and in Figure 3. In the Hanley fire, particularly near Calistoga, the timber was very heavy. Many homes and summer cabins are scattered through the hills in all three fire areas.

TABLE 1: ACRES BURNED BY FUEL TYPE -- THREE FIRES

Fuel Type	Acres Burned			
	Hanley Fire	Nuns Canyon Fire	Mt. George Fire	All Fires
Grass	--	1,500	400	1,900
Woodland	--	2,500	--	2,500
Grass-Woodland	--	--	6,000	6,000
Woodland-Grass	13,982	--	--	13,982
Brush	24,788	3,231	2,000	30,019
Timber	14,000	3,200	--	17,200
Totals	52,770	10,431	8,400	71,601

Principal tree species are Douglas-fir, black oak, white oak, alder, and madrone. Brush species consist principally of manzanita and ceanothus.

FIGURE 3

Hanley fire about 1:00 p.m., September 21, as it crosses Highway 128, spreading from North to South (left to right in picture). Fuel type is heavy fir timber, oak, manzanita, and grass. Wind is extremely strong.

Urban fuels consisted mostly of single story, single family residences. Homes damaged in the more built-up portions of Calistoga, Santa Rosa, and Boyes Springs were of substantial construction. Many of the structures destroyed in the hills outside of towns, however, were summer cabins and ranch buildings of lower value. (Figure 4.)

D. Weather -- During the ten-day period of September 18-27, the State of California experienced an extended period of critical fire weather. This weather contributed to the ignition of many fires, and made control more difficult. Weather records for the period are contained in Appendix E.

During this period, the entire state was under the influence of a large subsiding air mass which had moved in from the northeast, bringing wind velocities, temperature, and humidities more typical of southern California.

On September 18, the day before the Nuns Canyon and Hanley fires started, weather readings taken on Mt. St. Helena at 2:30 p.m. showed a temperature of 73°F, wind northwest at 14 miles per hour, relative humidity 10 per cent, fuel moisture 5 per cent, and brush burning, ignition, and fire load indexes of 60, 77, and 77, respectively, on a 100-point scale.

FIGURE 4

House burning on Franz Valley School Road, approximately 3:00 p.m., September 21 -- Hanley fire.

There was a brief lull on the following day, but the wind resumed that afternoon and continued through the 20th. On the 21st, the northerly winds reached their peak velocities and spread over most of the state. By the 22nd, the wind pattern was changing to the northeast and, while velocities were diminishing, the off-shore and down-slope flow of hot, very dry air carried across the state.

This pattern persisted through the 24th, then began to change by the evening of the 25th when pressure gradients relaxed, allowing marine air to move on-shore along the entire coastline. On the 26th, fog blanketed almost all of the north coast fire area.

E. Agencies and Fire Services Involved -- The three fires burned entirely on State-protected lands except where they entered the city limits of Santa Rosa, Calistoga, Napa, and Boyes Springs. All lands involved were privately owned.

Early in the disaster, the California Division of Forestry (C.D.F.) called in out-of-District overhead, equipment, and conservation camp crews. It also requested mutual aid assistance under existing agreements with nearby cities (Appendix F.) and from the California Disaster Office (C.D.O.) under the statewide master mutual aid agreement. (Appendix G.)

The operations included the following:

1. Fire services in direct control action:

   California Division of Forestry
   California Disaster Office
   25 Municipal Fire Departments (coming from as far away as Fresno, 190 miles from the area)
   Volunteer Fire Departments
   Fire Protection Districts

2. Agencies in support action:

   California Department of Corrections
   Air Force personnel from Hamilton Air Force Base
   The National Guard from Santa Rosa
   Military -- 1,500 men on standby at 11 bases
   California Highway Patrol
   Sheriffs Offices of two counties
   Power, Gas, and Telephone companies
   California Division of Highways
   Municipal Police Departments
   S.P.C.A. (Humane Society)
   Logging companies
   U.S. Weather Bureau

Many citizen volunteers also assisted, particularly in the urban areas during the peak threat.

The California Division of Forestry managed the entire fire, staffing all four fire camps and top positions on the fire line.

The forces employed at the peak of the threat are tabulated in Table 2. Total manpower involved was approximately 2,000 at the peak period.

TABLE 2: FIRE SUPPRESSION FORCES EMPLOYED (Number of Units)

Item	Fire			
	Hanley	Nuns Canyon	Mt. George	Total
Overhead	113	45	40	198
Pumper Crews *				
C.D.F.	34	14	18	66
C.D.O.	30	2	14	46
Other	40	35	12	87
Inmate Crews **				
Cons. Camps	21	13	12	46
Institutions	8	6	2	16
Bulldozers:				
C.D.F.	2	4	-	6
Other	47	7	9	63
Light Aircraft	2	1	1	4
Helicopters	2	1	1	4
Air Tankers	6	4	3	13
Fire Camps	2	1	1	4

*Average 2 men each
**Average 18 men each

These figures do not include support forces, such as State Highway Patrol, municipal and special police, county sheriffs, citizen volunteers, utility companies, equipment transport and repair units. Nor do they include the 1,500 military personnel on standby.

Additional statistics are given in the Appendix.

F. Chronological Course of the Fires

1. Hanley Fire -- The Hanley fire started at about 10:00 a.m. on September 19, in steep, rocky,timbered terrain.

(Figure 5.) By 8:00 p.m., it covered approximately 300 acres. During the night, it spread southeast through the difficult terrain of Palisade Ridge and by 6:00 a.m. the following day it had more than doubled in size.

By late on the 20th, lines had been completed around most of the fire's perimeter; but with the preponderance of timbered areas and increasing northerly winds, it escaped, moving downhill to reach the Palisade Mine by 10:00 p.m. From the Palisade Mine area, it moved into the outskirts of the city of Calistoga, where heavy structural losses were suffered between midnight and 6:00 a.m. on the third day. (Figure 6.) The fire was now approximately 6,500 acres in size, with its southern boundary along the northern edge of the city of Calistoga.

Throughout the third day, the fire continued to spread; by noon it had jumped across Highway 128 and was moving southwest toward the city of Santa Rosa. (Figure 3.) By midnight, it was in the outskirts of Santa Rosa, having travelled nearly 11 miles in 12 hours. Some 67 dwellings and numerous out-buildings were destroyed during this phase.

FIGURE 5

North (rear) side of Hanley fire, about 1:00 p.m., September 21, backing into wind through heavy timber.

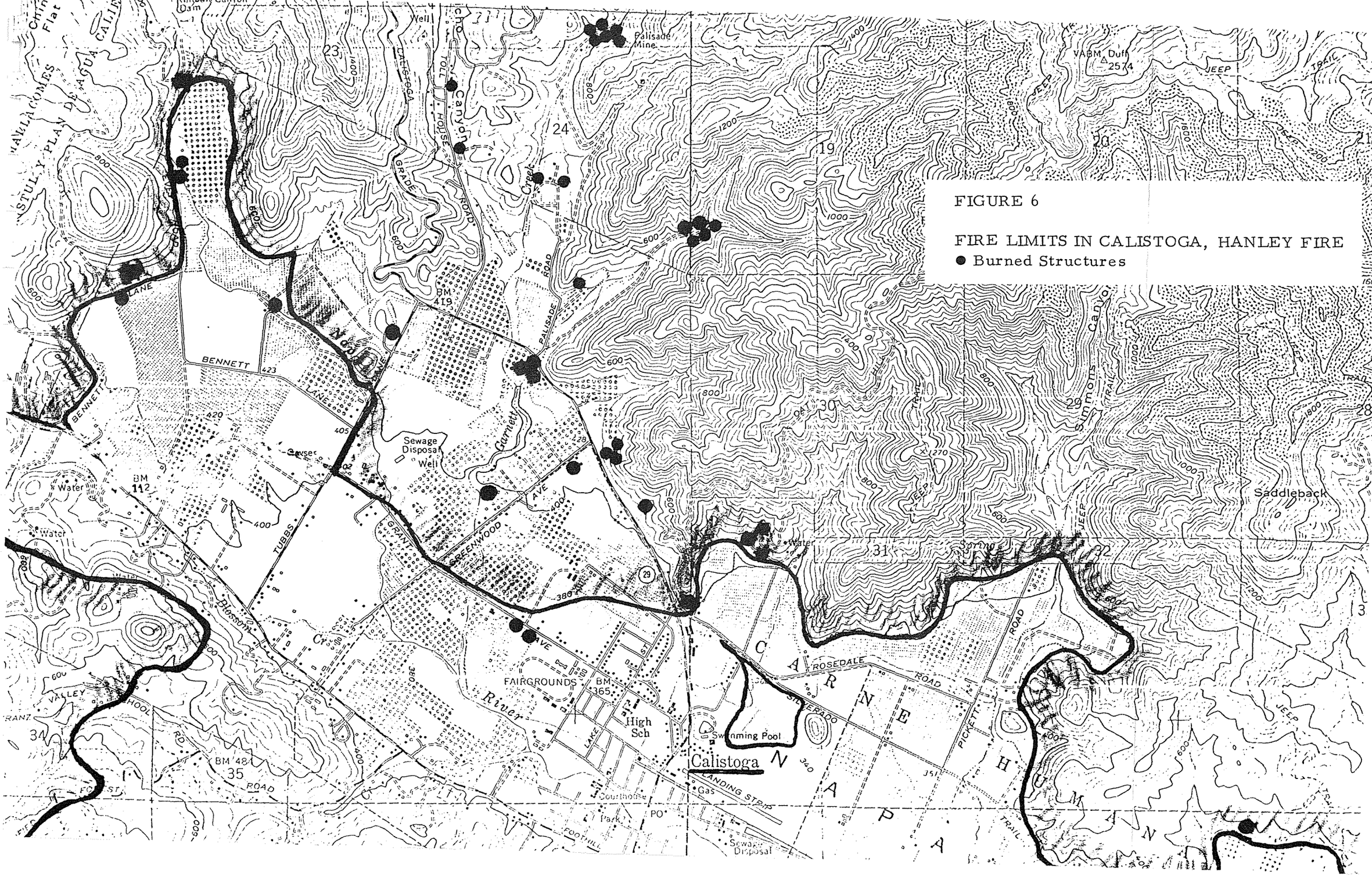


FIGURE 6
FIRE LIMITS IN CALISTOGA, HANLEY FIRE
● Burned Structures
Palisade Mine
Palisade Creek
Canyon
Sewage Disposal
Well
Garnett
Simmons Canyon
Saddleback
Calistoga
Swimming Pool
High Sch
FAIRGROUNDS
Courthouse
Park
PO
Gas
Sewage Disposal
Spring
Water
Geyser
BM 112
BM 419
BM 365
BM 481
VABM Duff
2574
BENNETT LANE
TUBBS LANE
GRANT AVE
GREENWOOD AVE
PALISADE ROAD
ROSEDALE ROAD
PICKETT ROAD
LANDING STRIP
FOOTHILL TRAIL
JEEP TRAIL
Blossom Creek
River
CALISTOGA
NAPA
MOUNTAINS

The fire spread on most fronts during the fourth and fifth days, but there were no major breakthroughs. By the end of the fifth day, lines were completed around the Sonoma section. The difficult terrain in the Napa section slowed line construction, but by the evening of the seventh day, September 25, the lines were completed and control was established at 52,770 acres.

2. Nuns Canyon Fire -- The Nuns Canyon fire started about 6:45 a.m. on September 19, approximately three hours before the Hanley fire. By midnight, the fire was contained on the west, south and east, and covered about 1,400 acres. A backfiring operation was scheduled to complete the north line, and cleanup work continued throughout the second day on the south, west and east fire lines. Approximately 2,000 acres had been burned, but control lines were virtually completed. (Figure 7.)

At about 6:30 a.m. on the third day, however, strong north winds caused the fire to jump control lines and spread to the southeast. The spread continued throughout the day and by midnight the fire covered the east side of Highway 12 to a point one half mile south of the Glen Ellen Forest Fire Station, a distance of about four miles. By noon on the fourth day, September 22, the fire had burned

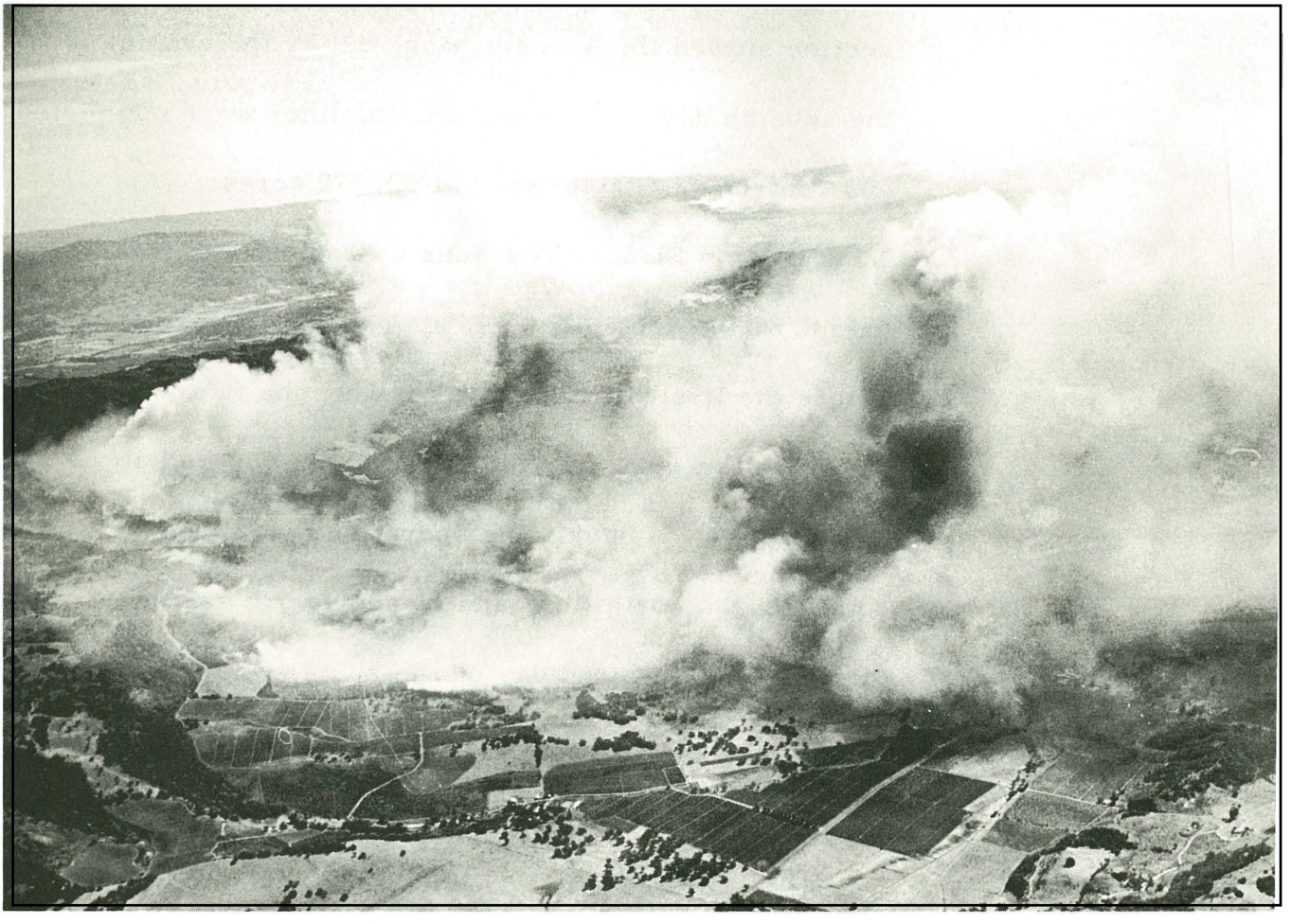


FIGURE 7

Nuns Canyon fire near Kenwood.

into the Boyes Springs community and destroyed some 26 dwellings. The fire was stopped in Boyes Springs. Only minor difficulties were experienced on the fifth day, and the fire was reported controlled at 8:00 p.m. on the sixth day, September 24, after consuming 10,431 acres.

3. Mt. George Fire -- This fire was discovered at 3:15 a.m., September 21, burning on both sides of Highway 37 (Monticello Road) northeast of Napa. By noon, the fire had spread nearly four miles to the southeast on a one-mile front.

The fire continued to spread at a much reduced rate through the following two days and was contained by 7:00 p.m. on the fourth day, September 24, after damaging 8,400 acres.

G. Casualties -- There were no fatalities in the fires, and only two serious injuries, both involving broken bones. Several minor burns were suffered by firefighters in the Hanley fire, and one crew which had sought refuge in a swimming pool received some gas when a chlorine tank was ruptured by the heat of the fire.

H. Rate of Spread -- During its main thrust into Calistoga, the Hanley fire spread two and one half miles in two hours, a

rate of one and one-quarter miles per hour. From the time it jumped Highway 128 the following day, until it reached Riebli Road outside Napa, it moved seven miles in six hours, an average of one and one-eighth miles per hour. Surface winds at the time were not measured, but were estimated at 40-50 miles per hour. Winds up to 70 miles per hour were recorded at the top of nearby Mt. St. Helena during this period.

In both of these instances, spotting was observed ahead of the main fire front. In the Franz Valley area of Sonoma County, ridge-to-ridge spotting was reported one-half to one mile ahead of the fire front. Spotting also was reported near Calistoga. Firebrands were believed to have been responsible for ignition of many buildings which were destroyed but were surrounded by unburned fuel.

I. Damage -- Fire damage from all causes in the three fires totalled $4,772,131. Suppression costs were $787,000, bringing the total cost of the fires to $5,559,131. A complete breakdown of damage is given below.

1. Damage to Improvements -- Acres burned and damage to structures and other improvements are shown in Table 3. These figures include the value of furnishings destroyed. The two most valuable single structures

burned were a lodge valued at $300,000 and a mansion valued at $250,000, both in the Hanley fire.

TABLE 3: DAMAGE TO IMPROVEMENTS

Fire	Acres Burned	Number of Structures	Value		
			Structures	Utilities, Fences, etc.	Total
Hanley	52,770				
(Calistoga)		70	$1,108,000	$187,500	$1,295,500
(Santa Rosa)		154	861,500	207,500	1,069,000
	52,770	224	1,969,500	395,000	2,364,500
Nuns Canyon	10,431	66	573,500	15,500	589,000
Mt. George	8,400	16	225,000	9,000	234,000
Totals	71,601	306	$2,768,000	$419,500	$3,187,500

2. Damage to Vegetation -- Damage to merchantable timber and damage to forage values including cost of reseeding are shown in Table 4 below. Reseeding work was completed shortly after the fire was controlled to minimize erosion.

TABLE 4: DAMAGE TO VEGETATION

Fire	Amount		Value		
	Merch. Timber(MBM)	Forage (ac.)	Merch. Timber	Forage	Total
Hanley	105,000	52,700	$1,260,000	$68,700	$1,328,700
Nuns Canyon	--	2,000	--	4,000	4,000
Mt. George	--	8,400	--	8,400	8,400
Totals	105,000	63,100	$1,260,000	$81,100	$1,341,100

3. Intangible Damage -- Estimated damage to watersheds and recreation values is listed below, Table 5.

TABLE 5: DAMAGE TO WATERSHED AND RECREATION (Est.)

Fire	Watershed	Recreation	Total
Hanley	$124,700	$100,000	$224,700
Nuns Canyon	10,431	--	10,431
Mt. George	8,400	--	8,400
Totals	$143,531	$100,000	$243,531

J. Rehabilitation -- Those portions of Napa and Sonoma counties affected by the three fires were declared a disaster area by Governor's proclamation and by the Federal government, making them eligible for rehabilitation benefits.

III. ANALYSIS

A. Utilization of Capabilities

1. Independent Action -- Numerous instances of independent action were observed in the fires, particularly during the peak of the threats to structures in Calistoga, Santa Rosa, Napa, Boyes Springs and homes scattered among the nearby hills. (Figure 8.)

In Calistoga, homeowners saved many buildings by wetting down the roofs and sides of structures with garden hoses. Instances were reported in which citizens whose own homes were hopelessly ablaze went to the assistance of neighbors whose own situations were not so hopeless. Homeowners were warned

FIGURE 8

Fire fighters taking independent action to save structures (to left, out of picture) about 3:00 p.m., September 21, near Franz Valley School Road, Hanley fire.

to evacuate, but many stayed in an attempt to save their homes. Some succeeded, at considerable personal risk.

State Highway Patrolmen assisted in directing traffic near Calistoga, and local police operated in the city. Police and sheriff's deputies handled evacuations.

When the fire entered Calistoga, the California Division of Forestry, the California Disaster Office, and mutual aid units were operating virtually independently. They fought the fire from house to house along rather narrow, twisting, steep streets amid thick vegetation. Each pumper crew would work on a house until it was saved or lost, then move on to the next. This action was extremely effective; the fire boss stated that the pumper crews did not lose a single house they worked on, other than those which were hopeless when they arrived. These crews confined their efforts to structures and let the fire spread in the adjacent vegetation.

Unfortunately there wasn't enough equipment to go around. One pumper per house would have been adequate to save many homes. Additional units

would have been required to control the fire in the brush. No backfiring was attempted during this period of urban threat.

After the Hanley fire jumped Highway 128, it spread across the 11 mountainous miles to Santa Rosa virtually unopposed. With winds estimated at 50 miles per hour fanning it onward at the rate of one and one-eighth to one and one-quarter miles per hour along a broad front, pumper crews could do little but fall back, saving structures as they came to them. Of necessity, the rural fire was left to run wild.

Most of the pumpers in this area belonged to the California Division of Forestry, and were coordinated via radio by the County Ranger, who accompanied the pumpers in his pickup truck. The close contact which was maintained under his coordination saved a portion of the numerous structures scattered among the mountains. A fire camp wasn't set up until the threat to Santa Rosa had ended.

When it became evident that the fire would threaten Santa Rosa, assistance was requested through the California Disaster Office. Most of it arrived in time to

help save the city. As the fire approached, all units were ordered out of the hills and massed to meet the main threat. As in Calistoga, the California Division of Forestry pumpers and Santa Rosa fire trucks, augmented by 40 or more California Disaster Office and municipal trucks, fought from house to house. Houses still were lost because there were not enough units. Several bulldozers were used to construct fire lines in vegetated areas between structures; no backfiring was attempted.

2. Mutual Aid -- The three fires occurred in portions of two California Division of Forestry Ranger Units -- the Napa-Yolo-Solano County and the Sonoma-Lake-Mendocino Units. These are two of the five Ranger units in the California Division of Forestry's District I, the north coast district. There are six districts in the state. An organization chart of the California Division of Forestry and a state map showing District boundaries are contained in Appendix H.

District I contracts with each county to provide fire protection for the county. The County Ranger Units enter into agreements with individual cities for day-to-day mutual aid. (Appendix F.) Some cities have

entered into mutual aid agreements with one another, and aid was supplied to some of the threatened cities under these agreements. In view of the large amount of outside assistance furnished in the disaster, the contribution of these local agreements was a minor one.

California Division of Forestry personnel and facilities are an important, integrated element of the State Fire Disaster Plan, which is coordinated by the California Disaster Office. (Appendices I and J.) The basic document is the Master Mutual Aid Agreement (Appendix G.), to which all fire services in the state are parties. The Plan specifies communication channels for requesting mutual aid. (Appendix K.)

The fire area was in Region II of the California Disaster Office where the Solano County Fire Warden is Regional Fire Coordinator. The Area Fire Coordinator for Sonoma County is the California Division of Forestry Ranger for the Sonoma-Lake-Mendocino County Unit. Many other California Division of Forestry personnel hold positions as Regional and Area Fire Coordinators in the California Disaster Office organization.

The fact that all of the field positions in the California Disaster Office fire service organization are filled by working fire service people, fire officials, and county and city fire chiefs, is largely responsible for the organization's success. Requests for assistance were properly channeled and forces supplied without delay on all three fires. (Figure 9.)

In the Hanley fire in Napa County and in the Mt. George fire, requests for mutual aid from fire command to the California Disaster Office were channeled through the Central Fire Station in Napa, where the chief is Napa County Area Coordinator. On the Hanley fire in Sonoma County and the Nuns Canyon fire, requests went through the California Division of Forestry's Napa County Unit headquarters in Santa Rosa. The County Ranger, who is also the California Disaster Office Area Coordinator, was a temporary fire boss in the Nuns Canyon fire.

During the fire emergency, the Regional Coordinator moved operations from Solano County to the Napa Central Fire Station where a pool of California Disaster Office equipment was maintained.

FIGURE 9

Mutual aid pumpers from the City of Vallejo, being filled with water. Green Valley area of Mt. George fire, near Napa.

The State Fire Disaster Plan specifies that the State Fire Coordinator in Sacramento refrain from acting on requests from Regions for assistance until the requests are channeled to him from the field. In practice, however, he keeps continuously informed on the statewide fire situation and usually anticipates developments long before they become critical. He then alerts Area and Regional Coordinators. This early alerting on the Santa Rosa fires had equipment and men ready to move immediately upon receipt of official requests, thus decreasing response times considerably.

3. Command -- In general, command capabilities were utilized effectively. On all three fires the ranking man in the initial attack force was in charge briefly until replaced by someone more experienced in command and administration. In most instances, the first man in charge was from one of the County Units and his replacement was from District I headquarters in Santa Rosa. The fire boss on the Napa side of the Hanley fire was brought in from the California Division of Forestry state headquarters in Sacramento. While the local men knew the country better than the District or Headquarters officials, it apparently was felt that competence in command

and administration were of overriding importance in the emergency.

The California Division of Forestry's regular fire camp organization was followed at all four camps. Each fire boss chose his control strategy and action independently. A central dispatch system was used for the fires in Sonoma County with requests funnelling through the California Division of Forestry County headquarters in Santa Rosa.

The District I headquarters in Santa Rosa provided support for all fire camps. Requests for additional men, equipment, and supplies went from the fire boss (through central dispatch in Sonoma County) to District headquarters. Requests for aid attack were handled by central dispatch directly with the Drop Coordinator controlling the aircraft. This coordinator was located at the Santa Rosa Airport; the aircraft were located there and at other fields in the area.

4. Communications -- All available means of communications were used effectively. There was overloading of the radio networks during the peak fire threat, however, and inability to contact mutual aid units because of dissimilar radio frequencies.

Command operated locally on the California Division of Forestry Local Fire Net and on the State Fire Net. Radio contacts with other Districts in the state were maintained via the State Operational Fire Net. In addition, the Civil Defense (C. D. O.) Radio Net was available to the fire boss, providing contact with all California Disaster Office pumpers, Area and Regional headquarters.

Radio communication vans provided and operated by the California Disaster Office were stationed at two strategic locations in the fire area. Each van contained receivers on the frequencies of Highway Patrol, sheriff, and many municipal fire departments. Through voice relay, the fire boss was able to contact most of the other fire services.

Telephones were available or were soon installed at all fire camps, but these lines also were overloaded at times. Existing telephone lines to Porter Creek on the Hanley fire were destroyed, but were repaired in time to be of use when the fire camp was established there.

Messages and maps were dropped from aircraft and helicopters delivered messages and maps and carried scouts.

5. Fire Weather Service -- the U.S. Weather Bureau assigned two mobile weather units to the fires (Figure 2) -- at the Glen Ellen fire camp in the Nuns Canyon fire and at the Bothe Park fire camp in the Hanley fire. Both units issued periodic fire weather forecasts and special forecasts as requested by the fire command.

6. Fire Behavior Forecasts -- Weather forecasts were interpreted in terms of fire behavior by the fire boss and his staff. None of the fire bosses had fire behavior teams whose sole duty it was to analyze and interpret the weather in terms of fire behavior. It appeared that such a team could have been used to good advantage in the fires.

B. Fire Suppression Problems

1. Organization -- There were few organizational problems. The biggest difficulties encountered were in supply; not enough hand crews, pumpers with crews, and aircraft for scouting and air attack were available at critical times.

As has been pointed out, many of the structures destroyed probably could have been saved had more pumpers been available.

It was recognized at the time that the additional fires cited in Section I tied up equipment which might otherwide have been used on the Hanley, Nuns Canyon, and Mt. George fires. There was a shortage of pumpers during the peak threat in every city where structures were lost.

The pumper shortage which occurred in the Mt. George fire in Napa on the fourth day of the crisis was a result of a critical need in Calistoga. Three pumpers were rushed to Napa, but they were not enough to handle the problems and they were delayed en route by going initially to the wrong fire.

Where the fires had been burning in the wildlands for several hours and the urban threat could be seen developing, men and equipment were ordered in advance, but it could not be ascertained whether the orders were filled in time.

There was a shortage of supervisory personnel in the Mt. George fire during the peak of the threat to Napa. A request for assistance from the fire camp at Bothe Park was not filled until some time later.

After the fire camp was set up at Porter Creek, on the fifth day of the crisis following the threat to Santa

Rosa, the fire boss requested several hand crews and supervisors to combat the rural sections of the Hanley fire. Because the Nuns Canyon fire was threatening Boyes Springs at the time, the crews were not supplied until several hours later. About this time, some supervisory personnel arrived in Santa Rosa by air from elsewhere in the state, but considerable time was lost in finding ground transportation to the fire camps. The lesson to be learned is that air transportation moves the men quickly, but its speed is of little avail if they are left stranded at the airport.

During the peak of the threat to Santa Rosa, some of the late-arriving mutual aid pumpers went directly to the fire without reporting in. This oversight apparently did not hamper their operation unduly. When the fire threat had subsided, some of these units also returned home without checking out, causing some confusion.

The Santa Rosa Fire Department appeared very reluctant to go even a short distance outside the city limits to meet the fire coming into the city. It was the opinion of some observers that control could have been

achieved sooner along certain sections of line had the municipal firemen been willing to move more freely outside the city limits.

Later in the Hanley fire, a chief from a distant city which was furnishing five engines became dissatisfied and ordered all of his units home without permission of the fire boss. This could have had a serious effect on the fire control effort had the fire broken out again; fortunately, it did not.

While fatigue among the top fire command, particularly the fire bosses, was a problem, it apparently had no adverse effect on the level of control strategy, tactics, or the outcome of the fires. In each fire there were long periods of emergency which exceeded the bounds of effective human functioning. In general, however, all fire bosses received short rest periods.

2. Supply -- There were no particular problems in the supply of tools and materials, except for the shortage of pumpers for urban fire fighting.
3. Scouting -- Aerial scouting from fixed-wing aircraft was an effective phase of operations. These aircraft were able to fly even during the high winds of the

fourth and fifth days when helicopters which were valuable for close-in scouting were grounded. The airborne experimental infrared scanner being developed by the Forest Service was used on the sixth day and good imagery of the fire was obtained through the dense smoke. Infrared shows promise for mapping fires both during the day and at night.

4. Air Attack -- At the peak of the fires, thirteen air tankers were in use. They were controlled by the Drop Coordinator at the Santa Rosa Airport and directed into the fire by lead planes from Santa Rosa, Angwin, and two other bases in the vicinity of the fires. All tankers were privately owned and under contract to the California Division of Forestry.

While the fires were out of control, there was almost continuous air attack during daylight hours, except during portions of the two days when aircraft were grounded by high winds.

Air attack was extremely effective. Many homes undoubtedly were saved by the chemical swaths laid down on brush near the homes, or, in some cases, directly on the structures themselves.

The aircraft flew 501 sorties and dropped 235,775 gallons of retardant on the three fires as shown in Table 6.

TABLE 6: SUMMARY OF AIRCRAFT USE

Fire	Air Tankers		Retardant Used (Gals.)				
	No.*	Trips	Bentonite	Phos-Chek	DAP	Fire-Trol	Total
Hanley	18	257	31,800	51,600	--	--	83,400
Nuns C.	13	140	79,400	--	19,200	3,400	102,000
Mt. G.	13	104	18,175	31,400	800	--	50,375
Totals		501	129,375	83,000	20,000	3,400	235,775

* A total of 19 individual air tankers were involved. Most were used on two or more fires

There were several cases in which air drops requested by the fire boss could not be supplied because of a shortage of air tankers. This shortage undoubtedly caused a number of homes to be lost and additional acres burned.

5. Evacuation -- In all four threatened cities, evacuation was handled by the sheriff's office and local police. The California Division of Forestry restricts its activities to fighting fires. With the exception of the Sonoma County hospital in Santa Rosa, evacuation was voluntary.

Although, as cited earlier, homeowners were warned to leave their homes, many stayed on to try to save their property.

The hospital, evacuated under supervision of the police, apparently had no existing evacuation plans. Neither did any of the four cities.

C. Successful Techniques for Saving Structures -- The most important structure saved by suppression action was the hospital, located on the edge of Santa Rosa. As the fire approached the structure, eight pumpers were massed in the parking lot, pumping a spray stream directly on the fire. They also wet down the side of the building. No ignitions occurred.

An electric substation near Calistoga also was successfully protected. Once again, firemen simply wet down the structure and surrounding vegetation, and pumped water directly on the fire.

Fire fighters were generally successful in protecting homes and structures when they could reach them in time. The most successful technique was to wet down the roof and walls. There apparently were no hydrant hookups during the peak of the threat to Santa Rosa because there wasn't time.

Many municipal fire trucks were at a disadvantage in rural operations because of insufficient tank capacity and lack of four-wheel transmission.

D. Pre-Disaster Planning

1. Prevention -- The urban fire departments in the areas under study carry on fire prevention campaigns. Municipal ordinances prohibiting the accumulation of weeds around structures are enforced and observed, but many homeowners have allowed flammable native brush to grow close to their homes. Such thick brush growth was found in all four cities where structures were lost. (Figure 10.)

   A recently-enacted state law required homeowners to maintain clearings around their homes and along private roads in brush areas. The California Division of Forestry is charged with enforcing this law and conducting prevention activity. Due to a shortage of prevention personnel, however, the law is not completely effective. The California Division of Forestry is concentrating on educating the public on the new law.

2. Training -- There is continuous in-service training, formal and informal, throughout the California Division of Forestry. The state maintains two training centers where forest fire truck drivers and forest firefighter foremen are trained. County Units and Districts conduct fire schools for their personnel, but there are no statewide nor District-wide

FIGURE 10

Residence saved by fire fighters in Boyes Hot Springs, Nuns Canyon fire.

fire command schools. Training on mock fire field problems is not conducted.

The city fire departments conduct training, but not in rural fire fighting. Training is carried on independently; the California Disaster Office does not conduct joint training for disasters at the local level.

3. Hazard Reduction -- The city ordinances against weeds and state laws against brush accumulations are steps toward an effective hazard reduction program, but there is no requirement for fuel-breaks or green belts in rural areas. Wood shingle roofs are permitted, adding significantly to the natural fuel hazards.

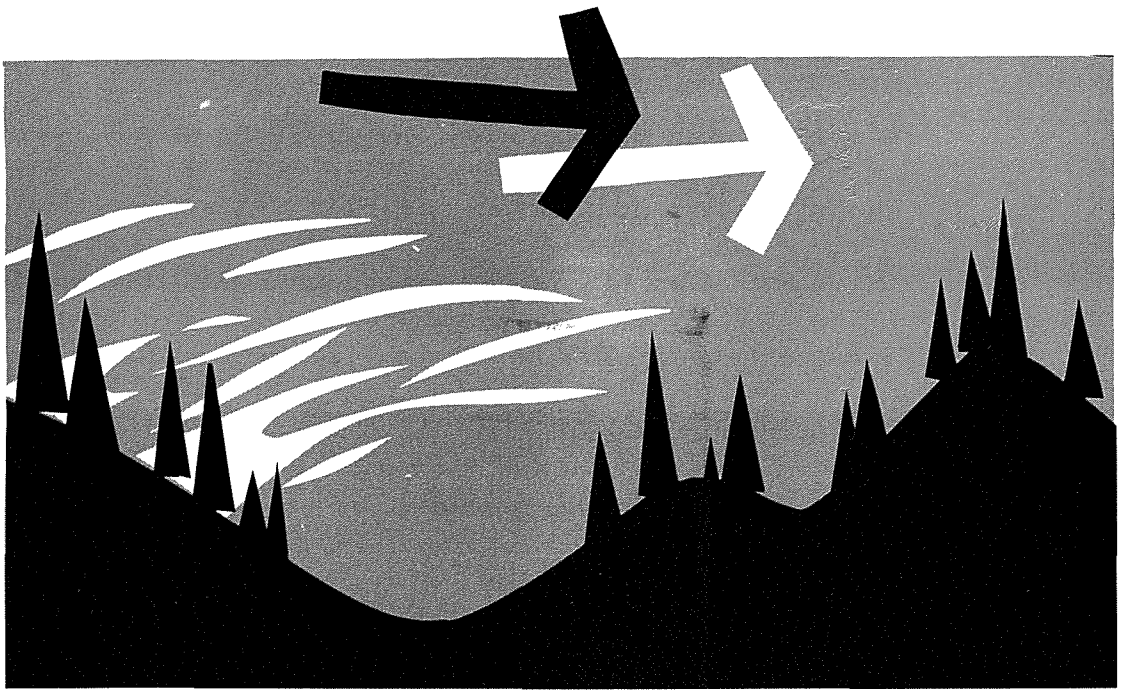
4. Evacuation -- Since apparently none of the cities in the fire area had prepared evacuation plans prior to the disaster, the evacuation was a spur-of-the-moment action. It seemed to be handled well, even though it was not binding on citizens. People evacuated or stayed behind, as they wished.

   In the hospital, the hospital administrators apparently ordered evacuation and it was carried out completely and effectively.

5. Utilities -- The utility companies were extremely effective in restoring service and repairing lines. Many

miles of electric and telephone lines and poles were burned, particularly in the Hanley fire. The companies were out in full force as soon as the fire passed; they worked around the clock until service was restored. They have large numbers of trucks, bulldozers, and boom trucks, many equipped with four-wheel transmissions. In a nuclear disaster, much of this equipment could be diverted to fire control uses and evacuation. Much of the equipment is stored on the city's fringes or in rural areas; thus it probably would survive the initial attack.

6. Civil Defense -- The state civil defense organization, the California Disaster Office, is generally held in high regard by the fire services. Its field fire organization, the Regional and Area Fire Coordinators, are all experienced, practicing fire officials. The permanent staff of the Fire and Rescue Division also are experienced fire officials and seem to know their jobs well.



IV. CONCLUSIONS AND RECOMMENDATIONS

These are the conclusions and recommendations of the author and those reviewing the study.

A. Conclusions

1. The trio of fires became a disaster primarily because of the unprecedented strong and persistent winds on the fourth, fifth, and sixth days. Low humidities and low fuel moistures contributed to rapid fire spread.
2. The synoptic weather pattern which produced conditions conducive to spreading was not unusual. But the fact that the pattern persisted in the fire area for as long as it did and produced winds as strong as it

did was unusual. Past weather records for Oakland a few miles to the south indicate that a fire load index of greater than 50 was recorded only six times in 10 years. During this fire emergency, the fire load index exceeded 50 on September 18, 19, and 22.

3. The fire services did not believe that such a disaster could happen to them, nor did they expect the adverse weather conditions to last for as long as they did. For these reasons, the fire services probably could be considered to have been somewhat unprepared for what followed.

4. There were many instances of shortages and tardy arrivals of manpower and equipment. These factors undoubtedly contributed to more acres being lost and possibly more structures being burned than would otherwise have been the case. It should be pointed out that most shortages and delays were attributable to the drain on resources caused by the numerous fires burning in the same general area. There simply weren't enough manpower and equipment to go around.

5. The strong winds and turbulence contributed indirectly to the spread of the fires by keeping the air tankers,

lead planes and helicopters grounded during the most critical phase of the threat.

6. In general, the mutual aid system functioned smoothly. Requests for assistance through the California Disaster Office were filled quickly and adequately in most instances.

7. Problems in the mutual aid area involved mostly equipment deficiencies and lack of proper training among the responding forces. Specific problems included:

   a. Units from some cities lacked adequate tank capacity to fight rural fires effectively.

   b. Many units were limited in rural areas because they lacked four-wheel drive transmissions.

   c. Topless cabs on some trucks seriously exposed the operators to heat, flame, and firebrands when they were working in tight situations, such as protecting individual structures.

   d. Lack of training in fighting forest fires reduced the effectiveness of operators of municipal units. Specifically, they didn't understand the need for cleanup activities and how to go about them, nor did they understand how to patrol a fireline.

8. It is doubtful if air attack could have stopped or materially retarded any of the fires during their major advances. Air drops were used effectively, however, to protect individual structures after the winds subsided; they saved some structures in the hills near Santa Rosa and in Boyes Springs. Air tankers were very effective when they could operate.

9. Lack of radio communication between mutual aid units and the California Division of Forestry materially decreased the effectiveness of responding units. These units could not be easily moved by the fire commander, nor could they be warned if they were threatened by the fire. Units failed to check in with the dispatcher when they arrived and some units returned home when it appeared to them that the fire threat was over. This occurred at the height of the fire threat to Santa Rosa and was due primarily to lack of communications and lack of a basic understanding of forest fire behavior.

10. Citizens will take independent action in fire emergencies to meet the common threat; there were many examples of such actions in the present emergency.

11. The Santa Rosa Hospital was saved by massing pumpers

near the structure, wetting down walls and pumping water on the fire.

12. Nearly 300 structures were lost, but many structures and possibly entire cities were saved by effective control action. The pumpers were especially effective in protecting structures.

13. Fatigue among top command, particularly the fire bosses, was a problem during the early stages of the fire. This was overcome by rotating command.

14. Assignment of the most competent individuals to command the fire, regardless of jurisdictional boundaries, is workable and effective.

15. Mobile communication and command center wires were flexible and effective.

16. Advantages of moving personnel by air can be lost through delays in getting them from the airport to the fire.

17. Unwillingness on the part of some urban firemen to work outside their jurisdictional boundaries, even a short distance outside, hampered effective control.

18. The infra-red scanner shows promise for scouting and mapping fires through smoke and at night.

19. The Civil Defense organization in California is very effective and held in high regard by the fire services.

B. Recommendations

1. Research should be strengthened on forecasting weather patterns associated with large fires.
2. Research should be strengthened on predicting local winds associated with these weather patterns.
3. Fire behavior specialists should be used more extensively in forecasting behavior on fires that have big fire potential.
4. Joint interagency training in disaster fire management should be instituted and uniformly applied.
5. A communications system adequate to handle traffic generated by emergencies of this size and complexity should be developed; it should include both hardware and operating procedures.
6. Consideration should be given to increasing the number of truck tanker pumpers for urban areas which can be threatened by fires in natural fuels; specifications should fit the areas' needs regarding tank capacity, four-wheel drive, capability to draft water, and closed or fire-shielded cabs.

7. Support should be given to development of night air fire-fighting operations to support and supplement ground operations.

8. Consideration should be given to increasing the authority and responsibility of the California Disaster Office in the field of training to manage fire disasters.

9. Training of urban firemen in rural fire fighting tactics and strategy should be supported.

10. Studies of the affects of fatigue on fire supervisory personnel should be supported.

11. Further use of air application of retardants on urban fires should be encouraged. It appears to have application to the protection of people in shelters.

12. The most competent personnel possible should be selected and trained for management of major fire emergencies, with only minor regard to jurisdictional boundaries.

13. Civil Fire Defense planning in California should be based upon a realistic appraisal of rural and urban fires which might result from nuclear attack.

14. Development and use of mobile command centers should be encouraged.

15. Mutual aid arrangements permitting firemen to act on the basis of the problem rather than on jurisdictional boundaries should be encouraged.

16. Development of infrared detection and mapping capability should be continued.

17. The Civil Defense organization and the California Disaster Office should be examined in more detail to determine why they are effective; lessons learned here should then be applied elsewhere.

V. APPENDICES

Appendix A. Conduct of Study

Appendix B. Individuals Interviewed

Appendix C. Summary Fire Statistics of the Three Study Fires (Exhibits 1, 2, and 3)

Appendix D. Summary of Large Fires Statewide in the Period September 18-27, 1964 (Exhibits 1, 2, and 3)

Appendix E. Fire Weather Records

Appendix F. Mutual Aid Agreement, California Division of Forestry and "City"

Appendix G. Master Mutual Aid Agreement, California Disaster Office

Appendix H. Organization Chart and District Map, California Division of Forestry

Appendix I. Fire Service Operations Chart, California Disaster Office

Appendix J. California Civil Defense Organization, Chart for Extreme Emergency

Appendix K. Channels for Requesting Mutual Aid through the California Disaster Office

Appendix L. List of Documents and Records on File

APPENDIX A

CONDUCT OF STUDY

CONDUCT OF STUDY

Personnel -- A single analyst, T. G. Storey, was assigned to this case study. He is a forester and Staff Specialist on Project 229, stationed at the Forest Fire Laboratory in Riverside, California.

Selecting the Fire -- Mr. Storey was assigned to the Santa Rosa area fires on Tuesday, September 22, by phone call from the Project Chief in Washington. He arrived in Santa Rosa Wednesday afternoon, September 23.

While Storey was en route, the Project Chief phoned ahead to the Regional Office of the Forest Service in San Francisco to notify them that the analyst was on his way and to get them to pave the way with the California Division of Forestry. The fire was entirely on State-protected lands.

In Santa Rosa, Storey contacted the Forest Service liaison man assigned to the fire from the Regional Office. He arranged contacts and interviews with key people in the C.D.F. fire control organization and others. Storey then proceeded with the study, working alone from then on.

Conducting Interviews -- Prior to making the actual interviews, the analyst endeavored to study the relationship of the interviewee to the purpose of the Project. At the interview the Project was defined, the interviewee's place in the suppression organization was determined, and the place of the interviewee's agency in the mutual aid system ascertained. The interviewee's opinion of the success or weakness of the present system as reflected on the present fire was ascertained and suggestions for improving overall results were solicited. Fire behavior data and descriptions also were obtained.

At the time of the contacts, supplemental information, such as manuals of instruction, maps, graphs, charts, lists, and pictures having a bearing on organization and fire behavior, were solicited.

Report Assembly -- Following the individual and agency contacts and collection of related material, interview reports were prepared by the analyst (Included as part of Appendix L.). These, along with other assembled material, were analyzed and appropriate decisions and evaluations made.

The results of the analytical work were appraised and incorporated into the final report.

APPENDIX B

INDIVIDUALS INTERVIEWED

INDIVIDUALS INTERVIEWED

Name	Position During Fire	Regular Position
Larry Richey	District I Headquarters Staff, C.D.F., Santa Rosa	Assistant Deputy State Forester, Dist. I, C.D.F., Santa Rosa
Robert McBride	U.S.F.S. Liaison Officer to C.D.F. on Santa Rosa Fires	State and Private Forestry, U.S.F.S., R-5, San Francisco
Clint Phillips	Special Fire Behavior Studies, C.D.F., Santa Rosa Fires	State Forest Ranger Research and Equipment Development, C.D.F., Sacramento
Louis E. Gunter	Fire Boss, Porter Creek Camp, Hanley Fire	Forester II, Range Specialist, Dist. I, C.D.F., Santa Rosa
L. R. Chatten	Fire Boss (2nd), Bothe Park Camp, Hanley Fire	Deputy State Forester, Research and Equipment Development, C.D.F., Sacramento
R. J. Smart	Fire Boss (1st), Mt. George Fire	Assistant State Forest Ranger, C.D.F., Napa
D. R. Martinelli	Fire Boss (1st), Hanley Fire, Napa Co. side	Assistant State Forest Ranger, C.D.F., St. Helena
F. Gowell	Coordinator at Ranger Unit Headquarters, St. Helena, Hanley and Mt. George Fires	State Forest Ranger, C.D.F., St. Helena

Name	Position During Fire	Regular Position
V. Ashby	Fire Boss (2nd), Nuns Canyon Fire, and Sonoma Co., Coordinator for Hanley and Nuns Canyon Fire	Associate State Forest Ranger, C.D.F., Santa Rosa
R. Matteoli	Fire Boss (1st), Nuns Canyon Fire	Assistant State Forest Ranger, C.D.F., Glen Ellen
G. H. Snow	Plans and Records, Nuns Canyon Fire	State Forest Ranger, Dist. I H.Q., C.D.F., Santa Rosa
F. H. Noyes	Fire Boss (2nd), Mt. George Fire	Forestry Superintendent, Parlan Fork Conservation Camp, C.D.F., Fort Bragg
Unknown	Dispatcher, Central Fire Station, Santa Rosa (Nuns Canyon and Hanley Fires)	Dispatcher, Santa Rosa Fire Department, Santa Rosa

APPENDIX C

SUMMARY FIRE STATISTICS OF THE

HANLEY, NUNS CANYON, AND MT. GEORGE FIRES

HANLEY FIRE STATISTICS — Exhibit 1

Started:	1000, Saturday, 9-19-64	
Location:	4 miles north of Calistoga, east of Highway 29 near Hanley's Resort at elevation 2350 feet on the southeast slope of the 4338 feet Mt. St. Helena	
Peak Threat:	To Calistoga: 0100 to 0400, Monday, 9-21-64 To Santa Rosa: 0030 to 0400, Tuesday, 9-22-64	
Contained:	Sonoma Section: 0500, Thursday, 9-24-64 Napa Section: 1800, Friday, 9-25-64	
Controlled:	Sonoma Section: 1800, Thursday, 9-24-64 Napa Section: 0600, Saturday, 9-26-64	
Control acreage:	Sonoma Section: 26,200 acres Napa Section: 26,500 acres Total: 52,700 acres	
Control perimeter:	60 miles	
Cause:	Hunter-Smoker	
Losses:	City of Calistoga and vicinity:	47 dwellings and miscellaneous outbuildings
	Sonoma Section, including Franz Valley, Petrified Forest, Mark West Springs, Rincon Valley, Riebel Road, Santa Rosa:	67 dwellings and miscellaneous outbuildings
Fire burned in:	Fire protection jurisdictions of: CDF Napa Ranger Unit; CDF Sonoma Ranger Unit; City of Calistoga; City of Santa Rosa; Rincon Valley Fire Protection District	

Hanley Fire Statistics -- 2

Forces at peak:	Overhead		113
	Pumper crews:	CDF	34
		CDO	30
		Other	40
	Inmate crews:	Conservation Camps	21
		Institutions	8
	Bulldozers:	CDF	2
		Other	47
	Helicopters		2
	Air Tankers		6
	Fire Camps:	St. Helena FFS, Both-Napa Valley State Park Marine Cooks & Stewards Training School, Porter Creek west of Petrified Forest	2

Exhibit 2

NUNS CANYON FIRE STATISTICS

Started:	0645, Saturday, 9-19-64
Location:	1 mile northeast of Kenwood and east of Highway 12
Peak Threat:	1100 to 1400, Tuesday, 9-22-64
Contained:	0500, Thursday, 9-24-64
Controlled:	2000, Thursday, 9-24-64
Control acreage:	10,431 acres
Control perimeter:	24 miles
Cause:	Power Line
Losses:	26 dwellings and miscellaneous outbuildings
Fire burned in:	Fire protection jurisdictions of: CDF Sonoma Ranger Unit, Glen Ellen Fire District, Kenwood Fire District, Valley of the Moon Fire District

Forces at peak:

Overhead		45
Pumper Crews:	CDF	14
	CDO	2
	Other	35
Inmate Crews:	Conservation Camps	13
	Institutions	6
Bulldozers:	CDF	4
	Other	7
Light Aircraft		1
Helicopters		1
Air Tankers		4
Fire Camps:	Glen Ellen FFS	1

Exhibit 3

MT. GEORGE FIRE STATISTICS

Started:	0315, Monday, 9-21-64		
Location:	1 mile east of Napa near Mt. George		
Peak threat:	0330 to 0500, Monday, 9-21-64		
Contained:	1900, Thursday, 9-24-64		
Controlled:	0800, Friday, 9-25-64		
Control acreage:	8400 acres		
Control perimeter:	24 miles		
Cause:	Incendiary		
Losses:	5 dwellings and miscellaneous outbuildings		
Fire burned in:	Fire protection jurisdictions of: CDF Napa Ranger Unit, Solano County Fire Warden		
Forces at peak:	Overhead		40
	Pumper crews:	CDF	18
		CDO	14
		Other	12
	Inmate crews:	Conservation Camps	12
		Institutions	2
	Bulldozers:	Other	9
	Light Aircraft		1
	Helicopter		1
	Air Tankers		3
	Fire camps		1

APPENDIX D

SUMMARY OF LARGE FIRES STATEWIDE ON STATE-PROTECTED LAND IN THE PERIOD SEPTEMBER 18 - 27, 1964

Exhibit 1

CALIFORNIA DIVISION OF FORESTRY

FIRE CONTROL JOB LOAD -- September 18-27, 1964
Zones I & II

	Forest Fires									Number of
Date	Incidence*	Acres Burned	Lightning	Camp Fires	Smoking	Debris Burning	Incendiary	Machine Use	Misc.	Non-Forest** Fires
18	26	3,824	-	-	7	1	2	5	11	10
19	42	66,652	1	-	11	5	14	7	4	15
20	33	373	-	1	10	4	7	2	9	4
21	44	14,259	-	-	11	4	16	3	10	9
22	19	15,673	-	-	9	1	2	3	4	3
23	24	375	-	-	9	1	6	4	4	8
24	40	2,093	6	-	9	2	11	5	7	10
25	23	199	-	-	5	2	6	5	5	8
26	18	19	-	-	2	1	3	9	3	7
27	15	58	-	-	5	-	4	1	5	6
Total	284	103,435	7	1	78	21	71	44	62	80

*A Forest fire is a fire originating in flammable vegetation or in structural, vehicle, improvement, or refuse sources which burns one-fourth acre or more flammable vegetation.

**A non-forest fire is a fire originating in structure, vehicle, improvement or refuse which does not burn one-fourth acre or more flammable vegetation.

SUMMARY OF LARGE FIRES STATEWIDE ON STATE-PROTECTED LANDS IN THE PERIOD SEPTEMBER 18-26, 1964

Origin Date	Name	Ranger Unit	Large Fire Cause	Control Date	Acreage
9/18	Smith-Holton	Humboldt	Structure	9/19	80
9/18	Roberts	Humboldt	R.I. Escape	9/20	2,850
9/18	Price	Tehama	Smoker-Hunter	9/18	800
9/19	Hanley	Napa	Smoker-Hunter	9/26	52,700
9/19	Nuns Canyon	Sonoma	Power Line	9/24	10,431
9/19	Horse Mtn. #2	Humboldt	Recreationist	9/21	65
9/19	Roadside #51 (Forest Hill)	Placer	Incendiary	9/23	4,600
9/20	Rockport	Mendocino	Children w/matches	9/21	90
9/20	Bureau of Reclamation	Napa	Incendiary	9/20	180
9/21	Roadside #42 (Mt. George)	Napa	Incendiary	9/25	8,400
9/21	Clover Valley	Lake	Incendiary	9/23	1,820
9/21	Conn Valley	Napa	Hunter	9/21	600
9/21	San Bruno	San Mateo	Children w/matches	9/21	1,552
9/22	Mill Creek	Sonoma	Structure	9/25	300
9/22	Nacomis	Mendocino	Unknown	9/24	90
9/22	Mattole	Humboldt	Incendiary	9/26	15,036
9/23	Singley	Mendocino	Unknown	9/24	150
9/24	Miller Canyon	Napa	Unknown	9/26	1,800
9/24	Roadside #79 (Annapolis)	Sonoma	Incendiary	9/24	40
9/25	Wilbur Springs	Lake	Incendiary	9/25	80

Exhibit 3

		District I		District II		District III		District IV		District V		District VI		Totals	
Day	Sept.	F*	NF**	F	NF	F	NF	F	NF	F	NF	F	NF	F	NF
Friday	18	7	2	8	3	6	-	2	-	-	-	3	5	26	10
Saturday	19	18	4	5	3	7	-	4	2	6	1	2	5	42	15
Sunday	20	17	1	9	1	3	1	1	-	2	-	1	1	33	4
Monday	21	18	3	7	1	10	1	-	1	9	2	-	1	44	9
Tuesday	22	4	-	5	1	4	-	1	-	-	-	5	2	19	3
Wednesday	23	6	3	6	2	10	1	-	-	2	2	-	-	24	8
Thursday	24	13	-	9	1	6	1	-	-	4	2	8	6	40	10
Friday	25	3	-	8	1	7	-	-	1	4	4	1	2	23	8
Saturday	26	-	2	-	-	6	-	2	-	9	2	1	3	18	7
Sunday	27	2	-	4	-	3	1	3	1	3	2	-	2	15	6
Totals		88	15	61	13	62	5	13	5	39	15	21	27	284	80
		103		74		67		18		54		48		364	

*"F" -- Forest Fire: A fire originating in flammable vegetation or in structural, vehicle, improvements, or refuse sources which burns one-fourth acre or more flammable vegetation.

**"NF" -- Non-Forest Fire: A fire originating in structure, vehicle, improvement, or refuse which does not burn one-fourth acre or more flammable vegetation.

APPENDIX E

FIRE WEATHER RECORDS

FIRE WEATHER RECORDS

SANTA ROSA FIRES, SEPTEMBER 18 - 23, 1964 [1/]

Station	Temp.	Sky Cond.	Wind	RH%	Fire Danger Index: Brush Burning	Fire Danger Index: Ignition	Fire Danger Index: Fire Load
September 18, 1964							
Mt. St. Helena	75	--	NW7	10	60	77	77
Mt. Jackson L. O.	85	--	SW10	21	10	63	12
Mt. Tamalpais	77	clear	NE5	32	--	--	--
Healdsburg	89	--	NW4	21	12	72	14
September 19, 1964							
Mt. St. Helena	75	--	N21	18	76	79	95
Mt. Jackson L. O.	95	--	NE18	12	50	93	77
Mt. Tamalpais	85	clear	NE8	13	--	--	--
Healdsburg	97	--	SW7	4	21	97	35

- - - - - - - - - - - -

1/ Mt. Tamalpais station read at 1:00 p.m., Healdsburg at 2:20 p.m. and Mt. St. Helena and Mt. Jackson L. O. at 3:30 p.m.

Station	Temp.	Sky Cond.	Wind	RH%	Fire Danger Index: Brush Burning	Fire Danger Index: Ignition	Fire Danger Index: Fire Load
September 20, 1964							
Mt. St. Helena	74	--	SW10	28	10	60	12
Mt. Jackson L. O.	86	--	NE12	19	20	82	29
Mt. Tamalpais	78	clear	NE7	27	--	--	--
Healdsburg	85	--	W14	28	27	63	27
September 21, 1964							
Mt. St. Helena	63	--	N58	16	--	--	--
Mt. Jackson L. O.	84	--	NE14	10	47	89	66
Mt. Tamalpais	70	clear	NE27	19	--	--	--
Healdsburg	--	--	--	--	--	--	--
September 22, 1964							
Mt. St. Helena	74	--	NE21	30	55	67	61
Mt. Jackson L. O.	95	--	NE10	9	28	97	43
Mt. Tamalpais	80	clear	NE10	18	--	--	--
Healdsburg	--	--	--	--	--	--	--

Station	Temp.	Sky Cond.	Wind	RH%	Fire Danger Index: Brush Burning	Fire Danger Index: Ignition	Fire Danger Index: Fire Load
September 23, 1964							
Mt. St. Helena	78	--	N17	23	26	60	27
Mt. Jackson L. O.	100	--	SW4	8	29	98	43
Mt. Tamalpais	85	clear	NE4	20	--	--	--
Healdsburg	--	--	--	--	--	--	--

APPENDIX F

MUTUAL AID AGREEMENT,

CALIFORNIA DIVISION OF FORESTRY AND "CITY"

AGREEMENT FOR MUTUAL FIRE PROTECTION AID

THIS AGREEMENT, made and entered into this _____ day of _____ 19___, by and between the _____ and the STATE OF CALIFORNIA, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF FORESTRY, through its duly qualified and acting State Forester, hereinafter called FORESTRY.

W I T N E S S E T H:

WHEREAS, _____ maintains and operates a fire protection organization in the area generally known as _____ and

WHEREAS, FORESTRY maintains and operates a fire protection organization for the purpose of providing protection to State responsibility lands which are adjacent or proximate to the area protected by _____ and

WHEREAS, it is the desire of the parties hereto to render aid each to the other to combat fire when such aid is necessary as herein set forth and

WHEREAS, the parties hereto desire to effect the purpose of this agreement pursuant to the provisions of the "Joint Exercise of Power Act" (Gov. Code Sec. 6500-6547) and/or Section ____ of Public Resources Code.

NOW, THEREFORE, the parties hereto mutually agree as follows:

1. To furnish fire protection personnel, equipment, materials and supplies and to render such fire protection services to each other as may be necessary to suppress fires of a magnitude that have developed, or appear likely to develop, beyond the control of a single party and therefore require the combined forces of the parties hereto.

2. Such mutual aid shall be provided within the limits of the County of _____; provided, however, that neither party shall be required to deplete its own fire protection resources, personnel, services and facilities to the detriment of its normal fire protection responsibilities.

3. No response to a mutual aid request provided for in this agreement will be made by the parties hereto unless such request is received through the established communication channels common to each party and is made by a responsible fire official of the party requesting such aid.

4. That any mutual aid under this agreement is extended with the express understanding that a responsible local fire official (in whose jurisdiction an incident requiring mutual aid has occurred) shall remain in charge at such incident including the direction of that personnel and equipment provided him through the operation of this mutual aid agreement.

5. Except as may be provided by separate agreement between the parties hereto, the assurance of mutual aid set forth herein shall constitute the sole consideration for the performance hereof and neither party shall be obligated to reimburse the other on account of any action taken or aid rendered hereunder or for any use of material, damage to equipment or liability incurred which may occur in the course of rendering the firefighting assistance herein provided for.

6. This agreement shall remain in full force and effect for a period of five years from the date hereinabove written unless sooner terminated by either of the parties hereto giving to the other fifteen (15) days notice in writing of such termination.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed as of the day and year first hereinabove written.

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL
RESOURCES

_____

By _____

By _____
Authorized Representative

DIVISION OF FORESTRY

_____

(Form approved by Department
of Finance 4-16-54)

End of Sec. 721

APPENDIX G

MASTER MUTUAL AID AGREEMENT

CALIFORNIA DISASTER OFFICE AND ALL FIRE ORGANIZATIONS

CALIFORNIA DISASTER AND CIVIL DEFENSE MASTER MUTUAL AID AGREEMENT

This agreement made and entered into by and between the STATE OF CALIFORNIA, its various departments and agencies, and the various political subdivisions, municipal corporations, and other public agencies of the State of California;

W I T N E S S E T H:

WHEREAS, It is necessary that all of the resources and facilities of the State, its various departments and agencies, and all its political subdivisions, municipal corporations, and other public agencies be made available to prevent and combat the effect of disasters which may result from such calamities as flood, fire, earthquake, pestilence, war, sabotage, and riot; and

WHEREAS, It is desirable that each of the parties hereto should voluntarily aid and assist each other in the event that a disaster should occur, by the interchange of services and facilities, including, but not limited to, fire, police, medical, and health communication, and transportation services and facilities, to cope with the problems of rescue, relief, evacuation, rehabilitation, and reconstruction which would arise in the event of a disaster; and

WHEREAS, It is necessary and desirable that a cooperative agreement be executed for the interchange of such mutual aid on a local, county-wide, regional, state-wide, and interstate basis;

NOW, THEREFORE, IT IS HEREBY AGREED by and between each and all of the parties hereto as follows:

1. Each party shall develop a plan providing for the effective mobilization of all its resources and facilities, both public and private, to cope with any type of disaster.

2. Each party agrees to furnish resources and facilities and to render services to each and every other party to this agreement to prevent and combat any type of disaster in accordance with duly adopted mutual aid operational plans, whether heretofore or hereafter adopted, detailing the method and manner by which such resources, facilities, and services are to be made available and furnished, which operational plans may include provisions for training and testing to

make such mutual aid effective; provided, however, that no party shall be required to deplete unreasonably its own resources, facilities, and services in furnishing such mutual aid.

3. It is expressly understood that this agreement and the operational plans adopted pursuant thereto shall not supplant existing agreements between some of the parties hereto providing for the exchange or furnishing of certain types of facilities and services on a reimbursable, exchange, or other basis, but that the mutual aid extended under this agreement and the operational plans adopted pursuant thereto, shall be without reimbursement unless otherwise expressly provided for by the parties to this agreement or as provided in Sections 1541, 1586, and 1587, Military and Veterans Code; and that such mutual aid is intended to be available in the event of a disaster of such magnitude that it is, or is likely to be, beyond the control of a single party and requires the combined forces of several or all of the parties to this agreement to combat.

4. It is expressly understood that the mutual aid extended under this agreement and the operational plans adopted pursuant thereto shall be available and furnished in all cases of local peril or emergency and in all cases in which a STATE OF EXTREME EMERGENCY has been proclaimed.

5. It is expressly understood that any mutual aid extended under this agreement and the operational plans adopted pursuant thereto, is furnished in accordance with the "California Disaster Act" and other applicable provisions of law, and except as otherwise provided by law that: "The responsible local official in whose jurisdiction an incident requiring mutual aid has occurred shall remain in charge at such incident including the direction of such personnel and equipment provided him through the operation of such mutual aid plans." (Sec. 1564, Military and Veterans Code.)

6. It is expressly understood that when and as the State of California enters into mutual aid agreements with other states and the Federal Government that the parties to this agreement shall abide by such mutual aid agreements in accordance with law.

7. Upon approval or execution of this agreement by the parties hereto all mutual aid operational plans heretofore approved by the State Disaster Council, or its predecessors, and in effect as to some of the parties hereto, shall remain in full force and effect as to them until the same may be amended, revised, or modified. Additional mutual aid operational plans and amendments, revisions, or

modifications of existing or hereafter adopted mutual aid operational plans, shall be adopted as follows:

(a) County-wide and local mutual aid operational plans shall be developed by the parties thereto and are operative as between the parties thereto in accordance with the provisions of such operational plans. Such operational plans shall be submitted to the State Disaster Council for approval. The State Disaster Council shall notify each party to such operational plans of its approval, and shall also send copies of such operational plans to other parties to this agreement who did not participate in such operational plans and who are in the same area and affected by such operational plans. Such operational plans shall be operative as to such other parties 20 days after receipt thereof unless within that time the party by resolution or notice given to the State Disaster Council, in the same manner as notice of termination of participation in this agreement, declines to participate in the particular operational plan.

(b) State-wide and regional mutual aid operational plans shall be approved by the State Disaster Council and copies thereof shall forthwith be sent to each and every party affected by such operational plans. Such operational plans shall be operative as to the parties affected thereby 20 days after receipt thereof unless within that time the party by resolution or notice given to the State Disaster Council, in the same manner as notice of termination of participation in this agreement, declines to participate in the particular plan.

(c) The declination of one or more of the parties to participate in a particular operational plan or any amendment, revision, or modification thereof, shall not affect the operation of this agreement and the other operational plans adopted pursuant thereto.

(d) Any party may at any time by resolution or notice given to the State Disaster Council, in the same manner as notice of termination of participation in this agreement, decline to participate in any particular operational plan, which declination shall become effective 20 days after filing with the State Disaster Council.

(e) The State Disaster Council shall send copies of all operational plans to those state departments and agencies designated by the Governor. The Governor may upon behalf of any department or agency give notice that such department or agency declines to participate in a particular operational plan.

(f) The State Disaster Council, in sending copies of operational plans and other notices and information to the parties to this agreement, shall send copies to the Governor and any department or agency head designated by him; the chairman of the board of supervisors, the clerk of the board of supervisors, the County Disaster Council, and any other officer designated by a county; the mayor, the clerk of the city council, the City Disaster Council, and any other officer designated by a city; the executive head, the clerk of the governing body, or other officer of other political subdivisions and public agencies as designated by such parties.

8. This agreement shall become effective as to each party when approved or executed by the party, and shall remain operative and effective as between each and every party that has heretofore or hereafter approved or executed this agreement, until participation in this agreement is terminated by the party. The termination by one or more of the parties of its participation in this agreement shall not affect the operation of this agreement as between the other parties thereto. Upon approval or execution of this agreement the State Disaster Council shall send copies of all approved and existing mutual aid operational plans affecting such party which shall become operative as to such party 20 days after receipt thereof unless within that time the party by resolution or notice given to the State Disaster Council, in the same manner as notice of termination of participation in this agreement, declines to participate in any particular operational plan. The State Disaster Council shall keep every party currently advised of who the other parties to this agreement are and whether any of them has declined to participate in any particular operational plan.

9. Approval or execution of this agreement shall be as follows:

(a) The Governor shall execute a copy of this agreement on behalf of the State of California and the various departments and agencies thereof. Upon execution by the Governor a signed copy shall forthwith be filed with the State Disaster Council.

(b) Counties, cities, and other political subdivisions and public agencies having a legislative or governing body shall by resolution approve and agree to abide by this agreement, which may be designated as "CALIFORNIA DISASTER AND CIVIL DEFENSE MASTER MUTUAL AID AGREEMENT." Upon adoption of such a resolution a certified copy thereof shall forthwith be filed with the State Disaster Council.

(c) The executive head of those political subdivisions and public agencies having no legislative or governing body shall execute a copy of this agreement and forthwith file a signed copy with the State Disaster Council.

10. Termination of participation in this agreement may be effected by any party as follows:

(a) The Governor upon behalf of the State and its various departments and agencies, and the executive head of those political subdivisions and public agencies having no legislative or governing body, shall file a written notice of termination of participation in this agreement with the State Disaster Council and this agreement is terminated as to such party 20 days after the filing of such notice.

(b) Counties, cities, and other political subdivisions and public agencies having a legislative or governing body shall by resolution give notice of termination of participation in this agreement and file a certified copy of such resolution with the State Disaster Council, and this agreement is terminated as to such party 20 days after the filing of such resolution.

IN WITNESS WHEREOF this agreement has been executed and approved and is effective and operative as to each of the parties as herein provided.

/signed/ EARL WARREN
GOVERNOR
On behalf of the State of California
and all its Departments and Agencies

(SEAL)

ATTEST:

/signed/ FRANK M. JORDAN
Secretary of State

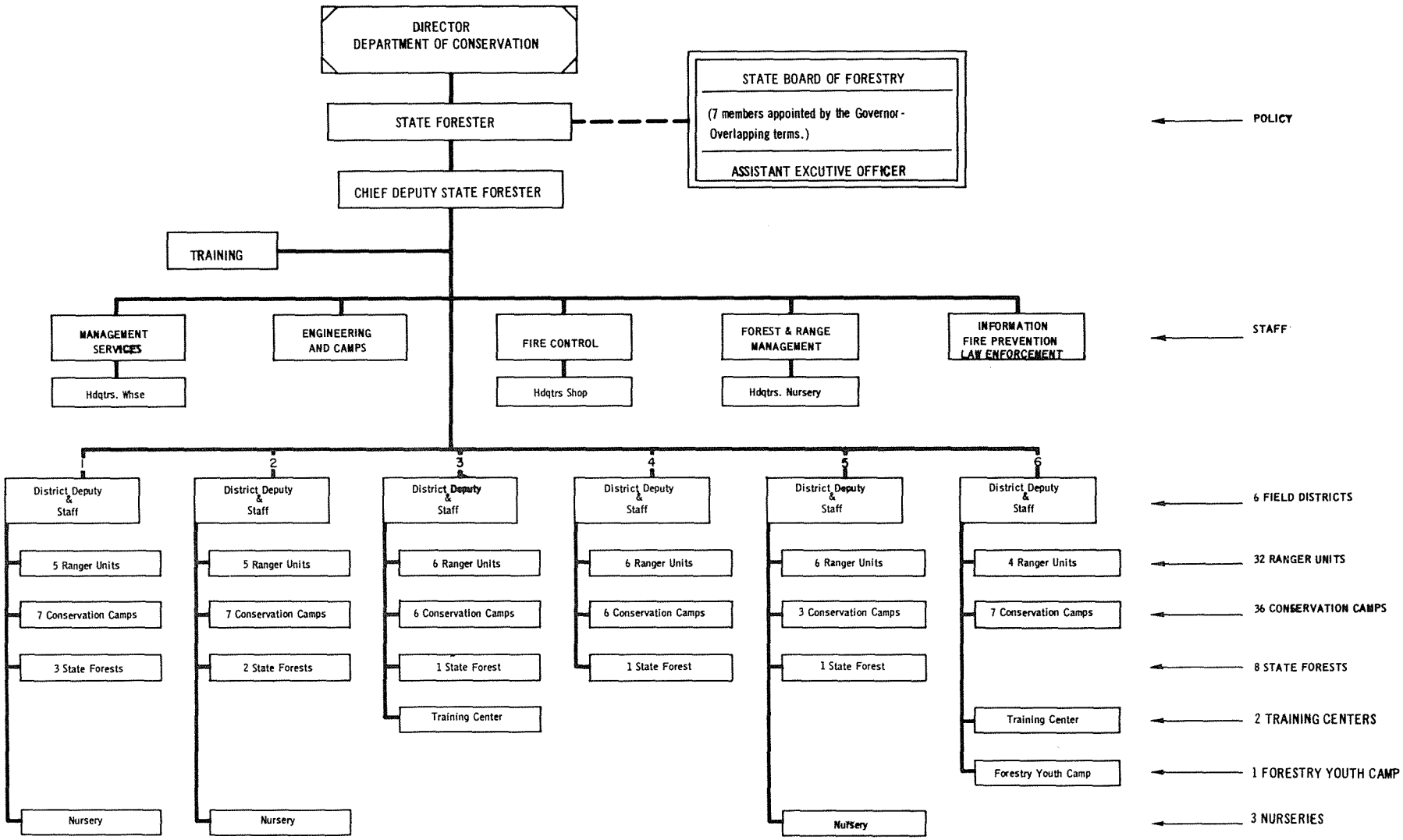
November 15, 1950

APPENDIX H

ORGANIZATION CHART AND DISTRICT MAP

CALIFORNIA DIVISION OF FORESTRY

DIVISION OF FORESTRY
DEPARTMENT OF CONSERVATION
THE RESOURCES AGENCY
STATE OF CALIFORNIA



APPROVED: 8-8

STATE FORESTER F. H. Raymond

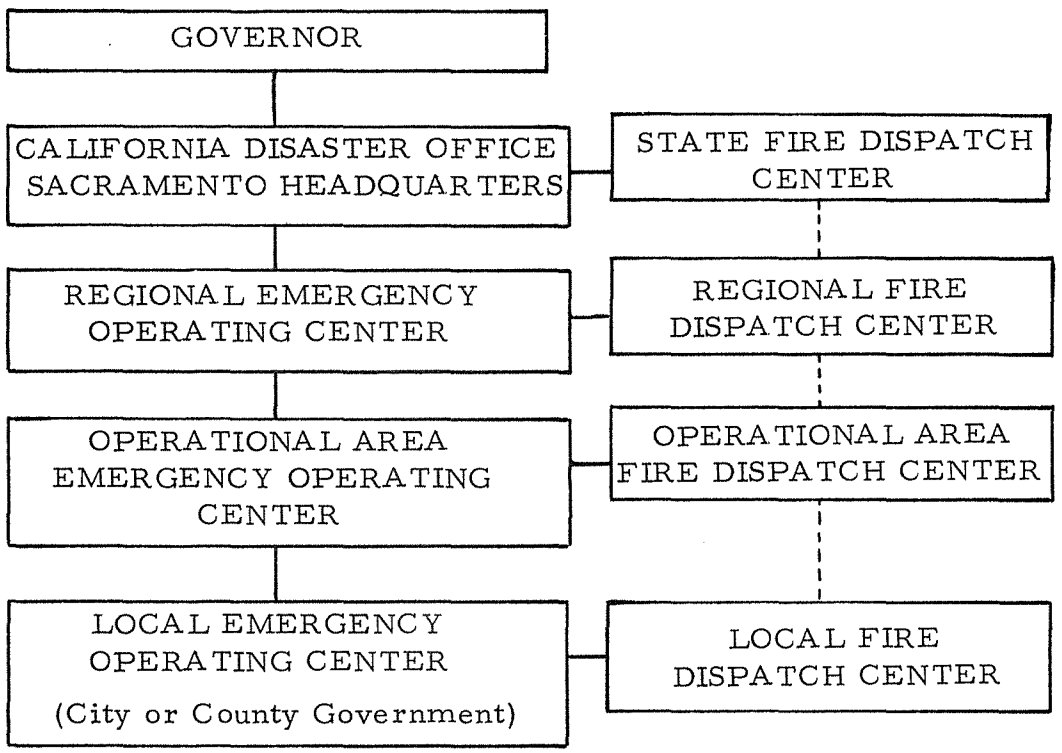
PRINCIPAL OFFICES AND INSTALLATIONS

APPENDIX I

FIRE SERVICE OPERATIONS CHART, CALIFORNIA DISASTER OFFICE

FIRE SERVICE
OPERATIONS CHART

State of Disaster
State of Extreme Emergency



———— Line of overall coordination and support.

- - - - - - - Line of coordination of fire operations and technical assistance.

Local officials are responsible for the conduct of operations within their geographical boundaries.

During a State of Disaster declared by the Governor, the Fire Service will be represented at emergency operating centers when requested by the appropriate Civil Defense Coordinator.

During a State of Extreme Emergency the Fire Service shall be represented at each emergency operating center.

APPENDIX J

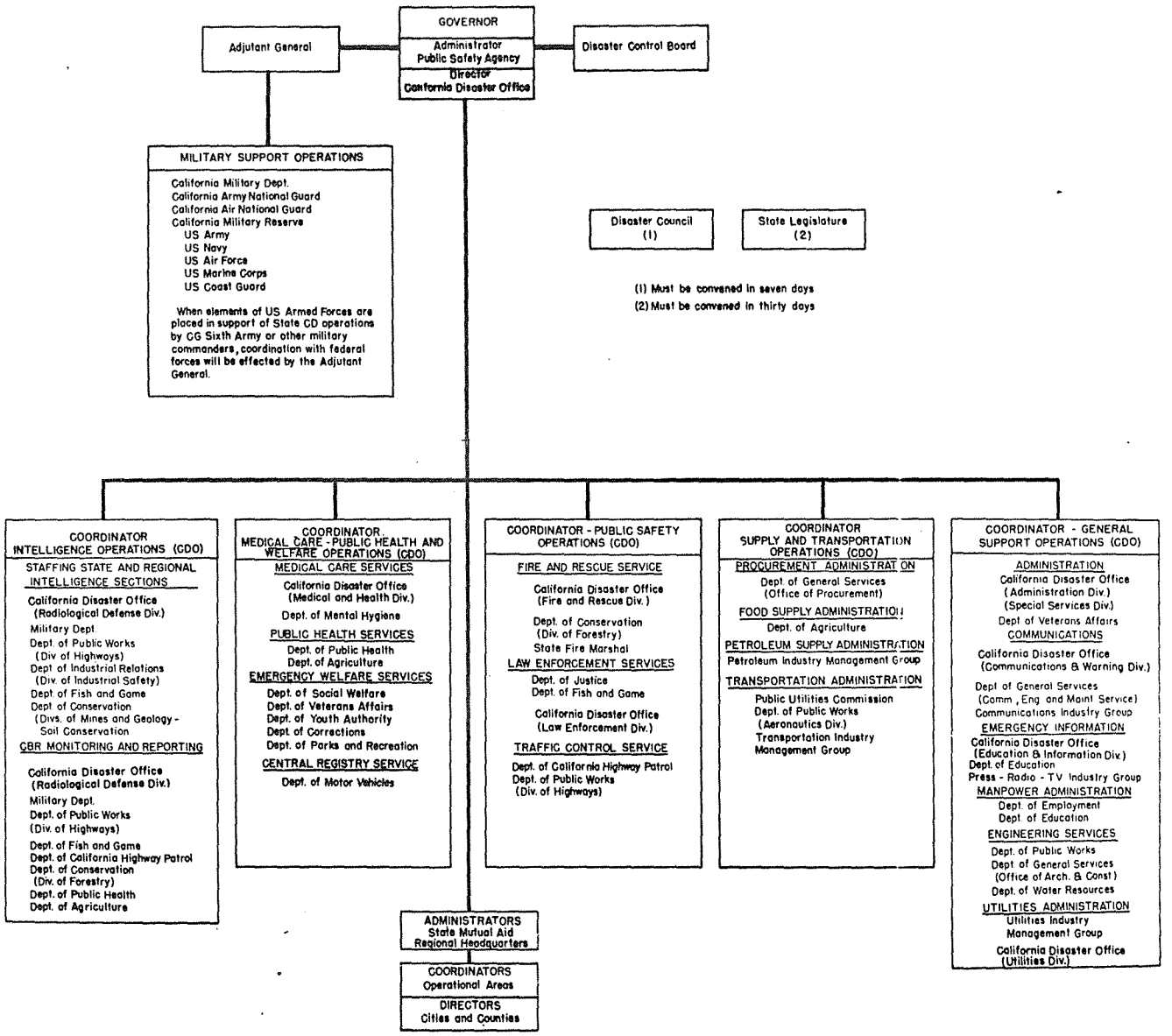
CHART FOR EXTREME EMERGENCY

CALIFORNIA CIVIL DEFENSE ORGANIZATION

STATE OF CALIFORNIA

CIVIL DEFENSE ORGANIZATION

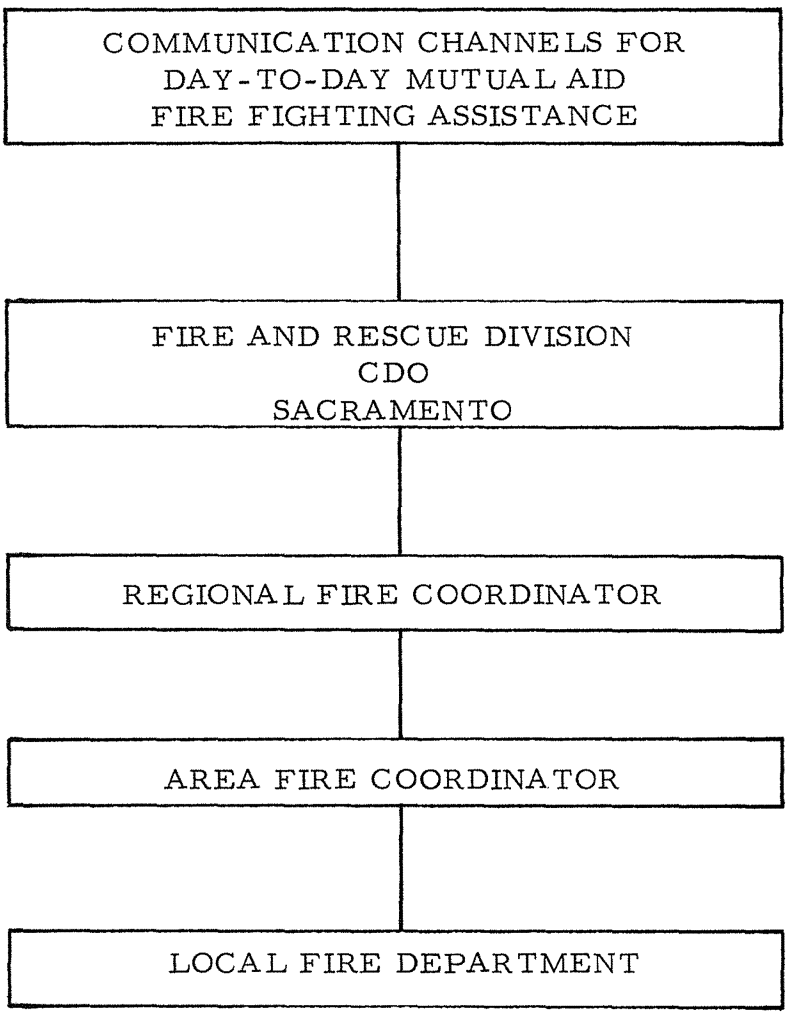
STATE OF EXTREME EMERGENCY


GOVERNOR
Administrator
Public Safety Agency
Director
California Disaster Office
Adjutant General
Disaster Control Board
MILITARY SUPPORT OPERATIONS
California Military Dept.
California Army National Guard
California Air National Guard
California Military Reserve
US Army
US Navy
US Air Force
US Marine Corps
US Coast Guard
When elements of US Armed Forces are placed in support of State CD operations by CG Sixth Army or other military commanders, coordination with federal forces will be effected by the Adjutant General.
Disaster Council (1)
State Legislature (2)
(1) Must be convened in seven days
(2) Must be convened in thirty days
COORDINATOR INTELLIGENCE OPERATIONS (CDO)
STAFFING STATE AND REGIONAL INTELLIGENCE SECTIONS
California Disaster Office (Radiological Defense Div.)
Military Dept.
Dept. of Public Works (Div of Highways)
Dept of Industrial Relations (Div. of Industrial Safety)
Dept. of Fish and Game
Dept. of Conservation (Divs. of Mines and Geology - Soil Conservation
CBR MONITORING AND REPORTING
California Disaster Office (Radiological Defense Div.)
Military Dept.
Dept. of Public Works (Div. of Highways)
Dept. of Fish and Game
Dept. of California Highway Patrol
Dept. of Conservation (Div. of Forestry)
Dept. of Public Health
Dept. of Agriculture
COORDINATOR MEDICAL CARE - PUBLIC HEALTH AND WELFARE OPERATIONS (CDO)
MEDICAL CARE SERVICES
California Disaster Office (Medical and Health Div.)
Dept. of Mental Hygiene
PUBLIC HEALTH SERVICES
Dept. of Public Health
Dept. of Agriculture
EMERGENCY WELFARE SERVICES
Dept. of Social Welfare
Dept. of Veterans Affairs
Dept. of Youth Authority
Dept. of Corrections
Dept. of Parks and Recreation
CENTRAL REGISTRY SERVICE
Dept. of Motor Vehicles
COORDINATOR - PUBLIC SAFETY OPERATIONS (CDO)
FIRE AND RESCUE SERVICE
California Disaster Office (Fire and Rescue Div.)
Dept. of Conservation (Div. of Forestry)
State Fire Marshal
LAW ENFORCEMENT SERVICES
Dept. of Justice
Dept. of Fish and Game
California Disaster Office (Law Enforcement Div.)
TRAFFIC CONTROL SERVICE
Dept. of California Highway Patrol
Dept. of Public Works (Div. of Highways)
COORDINATOR SUPPLY AND TRANSPORTATION OPERATIONS (CDO)
PROCUREMENT ADMINISTRATION
Dept. of General Services (Office of Procurement)
FOOD SUPPLY ADMINISTRATION
Dept. of Agriculture
PETROLEUM SUPPLY ADMINISTRATION
Petroleum Industry Management Group
TRANSPORTATION ADMINISTRATION
Public Utilities Commission
Dept. of Public Works (Aeronautics Div.)
Transportation Industry Management Group
COORDINATOR - GENERAL SUPPORT OPERATIONS (CDO)
ADMINISTRATION
California Disaster Office (Administration Div.)
(Special Services Div.)
Dept of Veterans Affairs
COMMUNICATIONS
California Disaster Office (Communications & Warning Div.)
Dept of General Services (Comm., Eng and Maint Service)
Communications Industry Group
EMERGENCY INFORMATION
California Disaster Office (Education & Information Div.)
Dept of Education
Press - Radio - TV Industry Group
MANPOWER ADMINISTRATION
Dept. of Employment
Dept. of Education
ENGINEERING SERVICES
Dept. of Public Works
Dept of General Services (Office of Arch. & Const)
Dept. of Water Resources
UTILITIES ADMINISTRATION
Utilities Industry Management Group
California Disaster Office (Utilities Div.)
ADMINISTRATORS
State Mutual Aid
Regional Headquarters
COORDINATORS
Operational Areas
DIRECTORS
Cities and Counties

APPENDIX K

CHANNELS FOR REQUESTING MUTUAL AID

THROUGH THE CALIFORNIA DISASTER OFFICE



Day to day mutual aid will be furnished on a voluntary basis.

Mutual aid plans should be approved by the governing body of the local fire department.

Mutual aid procedures should conform to prearranged plans prepared by the fire chief within the area.

The local fire chief requesting aid will be in charge of all manpower and apparatus sent to him.

APPENDIX L

LIST OF DOCUMENTS AND RECORDS ON FILE

LIST OF DOCUMENTS AND RECORDS ON FILE

Following is a list of materials on file in the Division of Fire Control, Forest Service, National Fire Coordination Study, Washington, D.C.:

1. Interview notes from individuals listed in Appendix B.

2. Hanley Fire: Overhead Activity Reports, Crew Activity Reports, Vehicle Summaries, and Air Tanker Activity Reports.

3. Nuns Canyon Fire: Same as above.

4. Mt. George Fire: Same as above.

5. Detailed Weather Records: Mt. St. Helena, Mt. Tamalpais, Mt. Jackson, Healdsburg.

6. Fire Data Sheets.

7. Fire Reports: Hanley, Nuns Canyon, and Mt. George fires.

8. Spread Chronology of Three Study Fires.

9. Fire Organization Charts for Hanley and Nuns Canyon fires.

10. Movement of Men and Equipment on the Three Study Fires.

11. Fire Limits in Napa, Mt. George Fire.

12. Fire Limits in Boyes Spring, Nuns Canyon Fire.

13. Fire Limits in Santa Rosa, Hanley Fire.

14. Detailed account of fire progress, including start and progress of other fires.

15. Supplementary Photographs (16)

16. Press Clippings from Oakland Tribune, San Francisco Chronicle, Santa Rosa Press Democrat, and Riverside Enterprise.